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COMMONWEALTH OF MASSACHUSETTS SUMMARY OF WATER QUALITY

1994

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COMMONWEALTH OF MASSACHUSETTS

SUMMARY OF WATER QUALITY

1994

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER POLLUTION CONTROL
BOSTON, MA

AND

OFFICE OF WATERSHED MANAGEMENT
NORTH GRAFTON, MA

EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
TRUDY COXE, SECRETARY
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
THOMAS POWERS, ACTING COMMISSIONER
BUREAU OF RESOURCE PROTECTION
DEAN SPENCER, ACTING ASSISTANT COMMISSIONER
DIVISION OF WATER POLLUTION CONTROL
JOHN HIGGINS, ACTING DIRECTOR
OFFICE OF WATERSHED MANAGEMENT
ANDREW GOTTLIEB, DIRECTOR

OCTOBER 1994

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SUMMARY OF WATER QUALITY 1994

DATE: OCTOBER 1994

REVIEWED BY:

Arthur Screpetis
Research and Demonstration
Program, Office of Watershed
Management

Warren Kimball
305b Coordinator
Office of Watershed Management

APPROVED BY:

John Higgins, Acting Director
Division of Water Pollution Control

Andrew Gottlieb, Director
Office of Watershed Management

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TABLE OF CONTENTS

TITLE	PAGE
List of Tables	iii
List of Figures	iv
1.0 Executive Summary	1
1.1 The 305B Process	1
1.2 Water quality Assessments	1
1.3 River Assessment	2
1.4 Lake Assessment	3
1.5 Marine Assessment	3
1.6 Recommendations and Special Concerns	4
2.0 Background Information	13
2.1 Water Resources	13
2.2 Classification of Surface Waters	13
3.0 Surface Water Assessment	17
3.1 Surface Water Monitoring Program	17
3.2 Assessment Methodology	23
3.3 River Assessment	32
3.4 Lake Assessment	39
3.5 Marine Assessment	50
3.6 Wetlands Assessment	57
3.7 Public Health/Aquatic Life Concerns	74
3.8 Public Water Supplies	81
4.0 Groundwater Assessment	85
4.1 Groundwater Discharge Permit Program	85
4.2 Other Groundwater Quality Issues	87
4.3 Timely Action Schedule and Fee Provisions	89
4.4 Causes and Sources of Pollution	89
5.0 Water Pollution Control Programs	91
5.1 Background	91
5.2 Point Source Program	91
5.3 Nonpoint Source Program	92
5.4 Cost/Benefit Assessment	92
5.5 Special Concerns	93
Bibliography	96

LIST OF TABLES

NUMBER	TITLE	PAGE
2.1	Surface Water Atlas	15
2.2	Water Use Classes	16
3.1	Surface Water Surveys	18
3.2	Publications	24
3.3	Guidelines for Use Support Determinations - Inland Waters	26
3.4	Guidelines for Use Support Determinations - Coastal and Marine Waters	29
3.5	Overall Use Support 1994 Assessment	34
3.6	River Assessment - Individual Use Support	35
3.7	River Assessment - Causes of Non-Support	36
3.8	River Assessment - Sources of Non-Support	37
3.9	Lake Assessment - Criteria for Use Support	40
3.10	Lake Assessment - Individual Use Support	42
3.11	Lake Assessment - Causes of Non-Support	43
3.12	Lake Assessment - Sources of Non-Support	44
3.13	History of Massachusetts Clean Lakes Program	47
3.14	Marine Assessment - Individual Use Support	51
3.15	Marine Assessment - Causes of Non-Support	52
3.16	Marine Assessment - Sources of Non-Support	53
3.17	Wetlands Acreage by Wetlands Type	58
3.18	County Wetland Acreage	59
3.19	Preliminary Estimates of Wetland Acreage	61
3.20	Notices of Intent	67
3.21	Fish Consumption Advisory List	75
3.22	Fish Kill Data	77
3.23	Contaminated Sediments	78
3.24	Acres of Shellfish Closures	80
4.1	DWPC Groundwater Regulation Section	84
4.2	Contaminated Groundwater Supplies	90

LIST OF FIGURES

NUMBER	TITLE	PAGE
1	River Assessment - Use Support	7
2	River Assessment - Causes and Sources of Non-Attainment	8
3	Lake Assessment - Use Support	9
4	Lake Assessment - Causes and Sources of Non-Attainment	10
5	Marine Water Assessment - Use Support	11
6	Marine Water Assessment - Causes and Sources of Non-Attainment	12
7	Altered and Replicated Wetlands	64

1.0 EXECUTIVE SUMMARY

1.1 The 305(b) Process

The Federal Clean Water Act (CWA) establishes a process for the development of information concerning the quality of the Nation's waters and reporting this information to the Environmental Protection Agency (EPA) and the U.S. Congress. Each state must develop a program to monitor the quality of its surface and groundwater and prepare a report every two years describing the status of water quality. This process, referred to as the 305(b) process, is the principal means by which the EPA, Congress, and the public evaluate water quality, the progress made in maintaining and restoring water quality, and the extent to which problems remain.

In 1988, EPA began the implementation of an automated data management system to record the results of water quality assessments and manage newly-required assessment information under the Clean Water Act of 1987. The Section 304(b) Waterbody System (WBS) is under implementation in Massachusetts and attempts to improve consistency in determining use support, measuring total state waters and assessing trends. The effort to implement these new guidelines in the 1992 report makes that report the baseline for trend analysis within the state, and for comparison with other states. This year's report continues that effort.

1.2 Water Quality Assessments

Waters are assessed to determine the levels of support for specific designated uses. The CWA establishes "fishable and swimmable goals" for all the nation's surface waters. For the purposes of this report the national goal uses are:

1. Aquatic life: a suitable habitat for the survival and reproduction of a native, naturally diverse community of aquatic flora and fauna.

2. Swimming - recreational activities with prolonged and intimate contact with the water with a significant risk of ingestion of water.

3. Fish Consumption - consumption of the edible portions of marketable fish or shellfish and the recreational use of fish, shellfish and other aquatic life or wildlife for human consumption.

4. Secondary Contact Recreation - recreation in which contact with the water is either incidental or accidental such as fishing, boating and shoreline activities.

The Department also assesses seven other uses including shellfishing, aesthetics, water supply and non-degradation where they are specifically designated.

The level of use support is rated in five categories:

1. Full Support - all designated uses are fully supported.

2. Threatened - all designated uses are fully supported but one or more uses may not support in the future, unless some action is taken.

3. Partial Support - recreational uses are not supported at certain times and/or aquatic life and fish consumption are generally supported with some qualifications.

4. Non-support - one or more of the uses are not supported.

5. Not Attainable - the use is not achievable because of natural or irreversible constraints.

It is important to realize that not all waters are assessed. Information is available only on a small subset of the state's waters and this subset is biased toward areas with known water pollution problems. When assessments are made the type of information used to make the assessment is also recorded:

1. Monitored Assessments - are based on monitoring data.

2. Evaluated Assessments - are based on qualitative information or monitored data more than five (5) years old.

In each assessment the pollutants that degrade water quality (causes) and the sources of these pollutants are also recorded. Common causes of non-support include pathogens, toxics, nutrients and turbidity. Sources include municipal and industrial discharges, combined sewer overflows and various nonpoint sources such as stormwater runoff and contaminated sediments.

1.3 River Assessment

Approximately 83% of the over 8,228 river miles in Massachusetts are unassessed and are not included in this report. These waters include almost all the small headwater streams and minor tributaries. The assessed waters include only 17% of the total river miles but consist of all the principal mainstem rivers and major tributaries. These rivers were severely polluted by industrial and municipal wastewater in the past. The Department's monitoring program was designed to detect and correct these problems, therefore the assessment is biased toward areas of known pollution. Of the river assessed, 34% are considered evaluated, meaning that the assessment is based on qualitative information or data more than five years old. This reflects shrinking state monitoring resources.

Progress toward cleaning up rivers is not displayed in overall use support. Fifty percent of the river miles assessed do not support one or more of their designated uses and this fraction has remained stable over the past few years. Progress toward cleanup is evinced more clearly in the individual use support. The reason for this is that the cleanup effort has targeted certain types (and sources) of pollutants first and left others untreated. Therefore rather than cleaning up any one river, a certain "layer" of pollution has been stripped away from all rivers. Nearly 81% of the river miles assessed support or partially support aquatic life (70% fully support). Over two-thirds of the river miles assessed are fully or partially swimmable. Industrial and municipal point sources no longer cause major impacts in rivers. Industrial point sources were abated by the NPDES permit program. Municipal discharges were cleaned-up by the joint federal and state Construction Grants Program that distributed over 2.5 billion dollars in sewage treatment grants to Massachusetts municipalities since 1967. One hundred thirty-nine (139) publically-owned treatment works are permitted under the NPDES program which collect and treat over one billion gallons of sanitary and industrial wastewater each day and serve 70% of the state population.

The cleanup of rivers is only half complete. Conventional pollutants (BOD, solids, turbidity, coliform bacteria) have been largely removed from point sources. Bacteria still impact nearly half of the assessed rivers which are contaminated by stormwater runoff and combined sewer overflows. Toxic pollutants impact nearly one-third of the assessed rivers. Half of these problems stem from contaminated sediment (PCB's, metals and pesticides); due largely to a history of prior pollution. These contaminants have accumulated in fish resulting in high levels in 23% of the assessed waters. Metals contamination from both point and nonpoint sources are a concern. In 1990 stringent criteria were adopted for these toxics, drawing more attention to them. Nutrients that escape secondary treatment at municipal plants or are carried to the rivers by stormwater impact 17% of the assessed waters. Overenrichment causes a secondary impact of dissolved oxygen problems.

1.4 Lake Assessment

Fifteen percent of the total of 151,173 acres of lakes were assessed for this report. About two-thirds of the assessments are considered evaluations because monitoring programs have been downsized and the original database is aging. Thus, although nearly 550 lakes have been surveyed by the Department's program only 210 were assessed this year.

Approximately half of the assessed lakes support their uses but over half of these are considered threatened. Most of the remaining lakes were rated as partial support with only 8% of the lake acres assessed as nonsupport. The national goal uses are generally well supported; 72% support aquatic life, 60% support swimming and 70% support secondary contact recreation. The highest nonsupport rating (29%) was for fish consumption even though many of the lakes were not rated for this use.

The causes of nonsupport include the proliferation of aquatic plants and excess nutrients; the sources of these pollutants were largely unknown, although stormwater runoff and other nonpoint sources are largely suspected. The assessment is heavily biased by the Department's lake survey methodology. The original intent of the lakes program was to detect eutrophication problems (from aquatic plants and nutrients) for the purpose of selecting lakes for restoration activities. Toxics remain largely unmonitored in lakes. Identification of sources of pollutants was not part of the original program.

Acid precipitation is also a concern in Massachusetts lakes. Data from the Water Resources Research Center at the University of Massachusetts for over 2,000 lakes indicated 515 as "critical", 398 as "endangered" and 432 as "vulnerable" with respect to acid precipitation.

The lakes assessment summary does not include the assessment of Quabbin Reservoir. The lake is 25,000 acres and therefore larger than the rest of the sample. Quabbin Reservoir is assessed as supporting all of its national goal uses except fish consumption. High levels of mercury in sport fish flesh is the subject of an ongoing study.

1.5 Marine Assessment

Marine waters can be arbitrarily divided into: 1) harbors and estuaries; and 2) open ocean areas. Water quality information is available for many harbors and estuaries, particularly the more populated areas with ongoing or planned pollution abatement projects. Data is scarce for open ocean areas. The Department's waterbody system contains 156 segments covering 224.13 square miles of harbors and estuaries. It does not contain open ocean areas. The Division of Marine Fisheries (DMF) assesses approximately 1,876 square miles of marine waters for shellfishing including nearly all of the Department's assessed areas. Although not intended for this purpose, The DMF area is used as a rough approximation of total marine waters so that the Department's assessment can be put in relative perspective. More accurate estimates of total coastal waters may be available for future reports.

The Department's assessment is heavily biased toward areas that were previously polluted. Over half (55%) of the assessed marine waters did not support one or more of their designated uses. The assessment is not considered representative of the overall quality of coastal waters. Looking at all of DMF's shellfishing data only 7% of this much larger sample of coastal waters did not meet the shellfishing use. Since this use demands very high quality water it can be assumed that coastal waters are much cleaner than indicated by the Department's assessment.

The assessment shows that marine waters are lagging behind the river cleanup. Only 28% of the assessed waters fully supported their uses. However all the major urban areas on the coast are either in facilities planning or construction phases of new clean up efforts. Foremost among these is a massive project to

cleanup Boston Harbor. Preliminary sewer system rehabilitation and improvements in sludge handling have already made positive impacts on this environment.

When uses are examined individually nearly half (49%) of the assessed waters support aquatic life fully. Over 80% of the waters fully or partially support primary and secondary contact recreation.

The major cause of nonsupport in marine waters is bacterial contamination. This is the cause of major impacts on one-third of the waters assessed and moderate and minor impacts on another one-third of these waters. The predominant sources of these bacteria are stormwater runoff and combined sewer overflows although other sources may contribute. Cleanup of combined sewer overflows is underway in many locations. Cleanup of stormwater runoff will undoubtedly lag behind until regulatory procedures are better established.

Toxic contamination of marine waters is demonstrated by areas of contaminated sediments in Boston Harbor, Quincy Bay, areas of the North Shore and Buzzards Bay. These are areas of historical pollution and pose special problems for cleanup efforts; but experience gained in the on-going Buzzards Bay cleanup may provide insight for future efforts.

Municipal point sources impact 35% of the waters assessed. These impacts include nutrient enrichment and toxicity from ammonia. Facilities planning in the major urban areas should correct these problems.

Approximately 40% of the waters assessed received impacts from unknown sources. The complexity of marine hydrology makes it sometimes difficult to attribute cause and effect. This fraction will have to be reduced in order to better sort out the relative contributions of point and nonpoint sources and better resolve the number and types of nonpoint sources.

1.6 Special Concerns and Recommendations

1. Widespread Contamination of Water Supplies

   The number of public water supply systems being closed due to contamination is increasing. In order to reverse this trend monitoring is being expanded. An inventory of tributaries to surface water supplies has been completed to be used in new surface and groundwater regulations to provide more protection. Ultimately, there must be better stewardship of land areas surrounding wells, reservoirs and recharge areas.

2. Loss of Wetlands

   Valuable wetland areas are decreasing in the state, but there is no systematic means of measuring these losses. Statewide wetlands mapping is being improved to determine the current status of wetlands. Critical wetland resources, such as recharge areas, should be delineated for protection. Improved wetland regulations, with better coordination with the surface water quality standards, are being promulgated. Currently, wetlands are protected under the antidegradation provisions of the surface water quality standards. Additional protection through classification and criteria will be pursued.

3. Coastal Water Quality Degradation

   Unlike other waterbody types, marine water quality has noticeably deteriorated on parts of the coast over the last ten years. This is especially true in areas such as Cape Cod where nonpoint source pollution has resulted in a ten-fold increase in shellfish beds closures. This downward trend indicates that more management of development and the abatement of nonpoint sources of pollution will be necessary. Point source abatement measures are well underway. Several municipal wastewater facilities have been upgraded from primary to secondary treatment, and

plans for upgrading most of the remaining facilities are completed. Upgrading of Boston's Deer Island facility is underway, and already, improvements to the facility have eliminated the discharge of sludge and reduced the impact of combined sewer discharges in Boston Harbor.

4. Prevention and Control of Nonpoint Sources

Pollution due to point sources is rapidly being reduced in river waters. Point sources to marine waters are currently being addressed, and point sources to lakes are largely prohibited. The control of nonpoint sources of pollution is becoming the most important measure to achieve federal CWA objectives. Stormwater runoff and land disposal need to be examined for best management practices of pollution abatement. New methods of monitoring need to be developed in order to: 1) measure previously unmonitored areas of the state for nonpoint source pollution; and 2) distinguish nonpoint source pollution from point source pollution. Improved monitoring of nonpoint sources, such as wet weather sampling, may result in some waterbodies being reassessed from support to partial and nonsupport of uses. A new emphasis on stormwater permitting will result in greater regulation of this source of pollution.

5. Evaluation of Toxic Pollutants

Toxic pollutants affect many of the state's waterbodies. The exact nature and extent of the problem is not known because the monitoring program has been inconsistent. Parametric coverage has increased over the years and more sophisticated methods of analysis have improved detectability. Statewide toxic monitoring for all waterbody types needs to be implemented in a systematic manner. Chemical by chemical monitoring cannot succeed because of the seemingly limitless number of chemicals to be measured. Therefore a program of biological toxicity testing must be implemented to supplement chemical testing. In order to interpret results of monitoring, additional criteria are needed especially for sediments and fish flesh. The evaluation of toxicity must include three components: 1) human health; 2) aquatic life; and 3) bioaccumulation.

6. Threatened Lakes and Ponds

Most of the lake waters that currently meet water quality standards are perceived to be threatened. The causes are cultural eutrophication and acid precipitation. Cultural eutrophication must be controlled by comprehensive watershed management including public education, nonpoint source control and zoning laws. The only long term solution for acid precipitation is source control; lake liming is only an interim measure. Lakes that are currently polluted will be helped by increased attention to nonpoint source control, but reallocation of funding for the State Clean Lakes Program is also needed. Indications are that the current subsurface disposal regulations are inadequate to protect lakes. Revised regulations and better enforcement of regulations are needed.

7. Treatment Facility Upgrading and O&M

Significant gains in water quality have been made through the construction of wastewater treatment facilities. It is essential that this investment be protected through the proper operation and maintenance of these facilities. Operator education programs and funding for maintenance and upgrading or rebuilding facilities are also needed.

8. Policy for Cleanup of Combined Sewer Overflows

Most of the major urban areas in Massachusetts have combined sewers. The construction of treatment plants for municipal point sources and the advent of best management practices for nonpoint sources leaves these significant sources of pollution unaddressed. The Department has adopted

a CSO policy that provides engineering targets for cleanup where sewers remain unseparated. EPA has recently adopted its own CSO policy. The Department's policy must be reconciled with the national policy so that the state can move forward on abatement actions.

9. Contamination of Fish Flesh and Sediments

The historical pollution of certain waters has left a legacy of contaminated sediments/fish flesh. This type of pollution will not be remedied by the conventional means; i.e., the construction or upgrading of wastewater treatment plants. Therefore, further study is needed into the methods of abatement and the means of implementing these measures when the polluter may no longer be present.

10. Biomonitoring

Biomonitoring data has proven invaluable in the river assessment. As monitoring resources decrease, the need for biological monitoring becomes more evident. A minimum program must be maintained for rivers; and programs need to be develop for lakes, wetlands and marine waters. As data are collected regulations can be improved by the development of biological criteria.

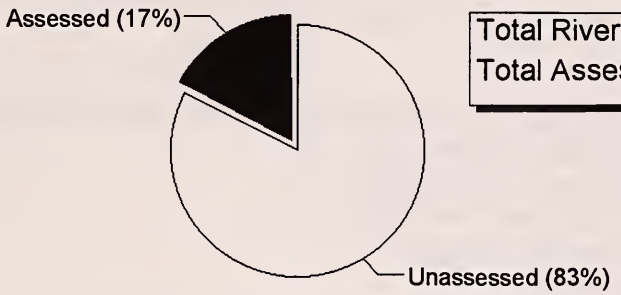
11. Monitoring Program

The Department's monitoring resources have been decreasing in recent years and this trend is expected to continue. Better coordination and exchange of information with other agencies is needed. More extensive use of qualitative information must also occur. Improved outreach and citizen's monitoring must also be explored.

Figure 1

River Assessment

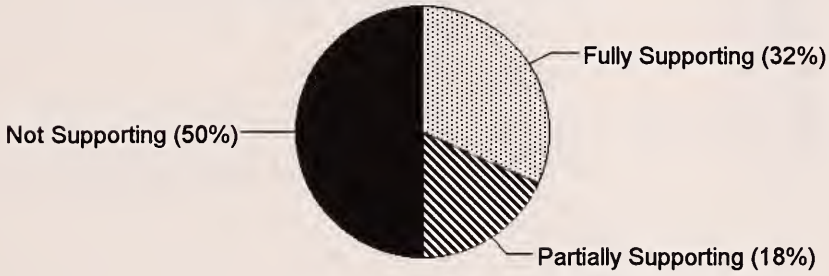
River Miles Assessed



Total River Miles = 8,229 miles
Total Assessed = 1,425 miles

Level of Overall Use Support

(Percent Assessed River Miles)

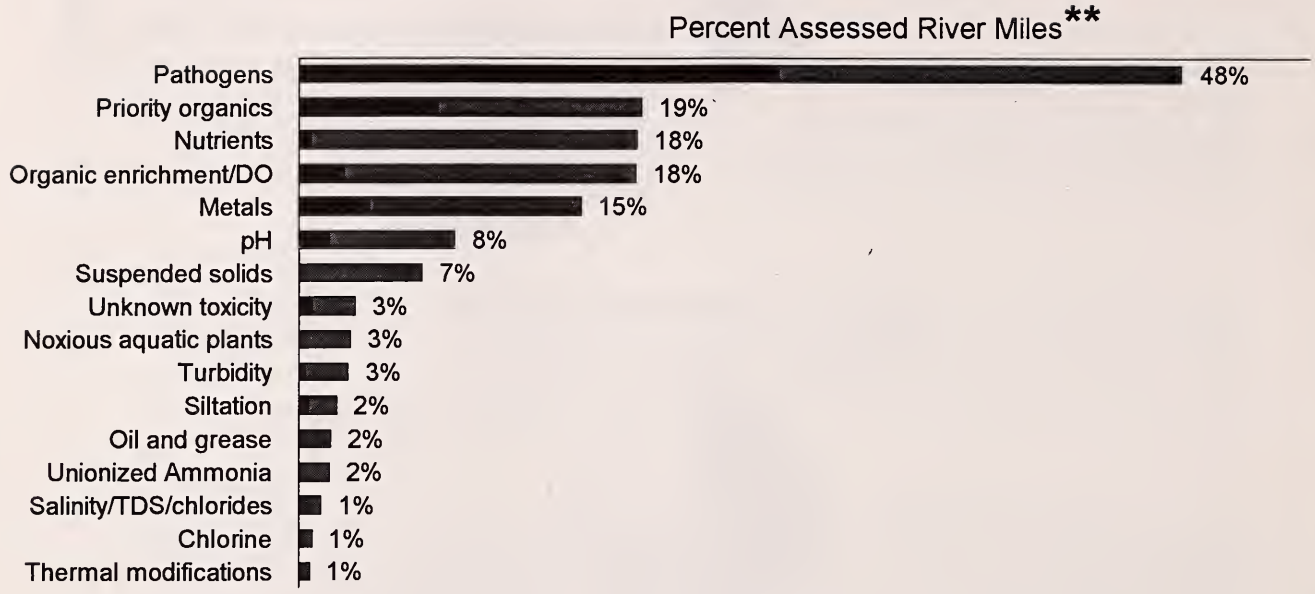


Percent Assessed River Miles

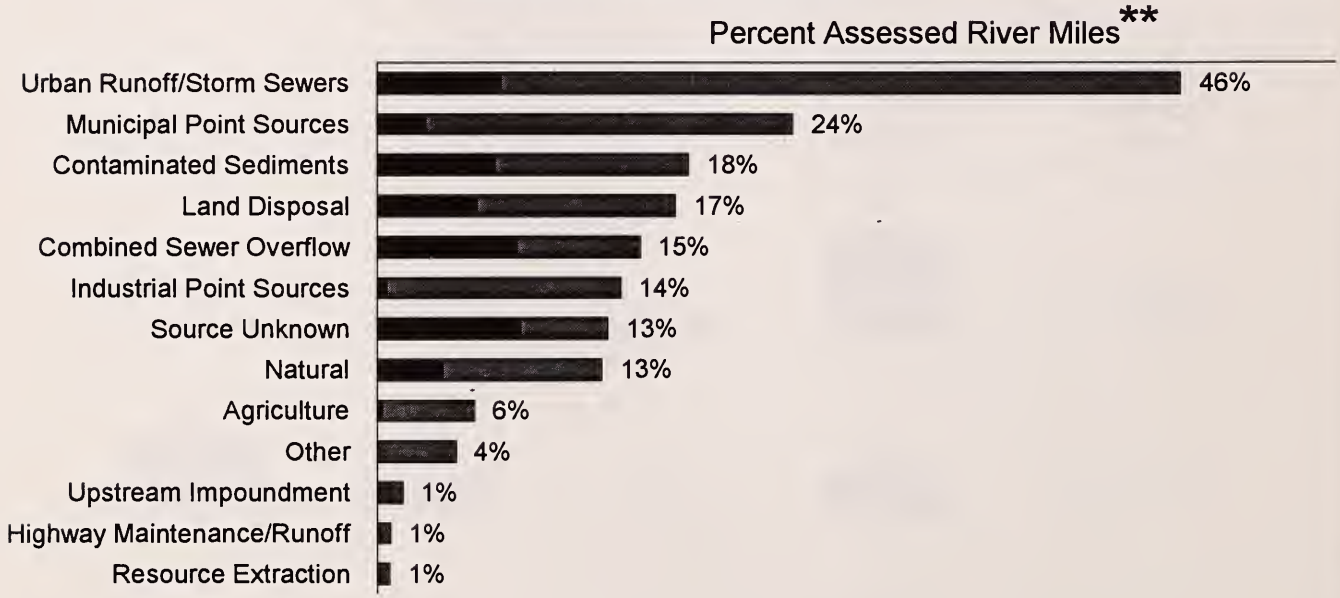
Individual Use	Fully Supporting	Partially Supporting	Not Supporting	Not Rated
Aquatic Life Support	70%	11%	15%	5%
Fish Consumption	29%	0%	22%	49%
Primary Contact-Swimming	46%	22%	26%	6%
Secondary Contact	73%	12%	8%	6%

Figure 2
River Assessment

Pollutants/Causes of Non-Support



Sources of Non-Support



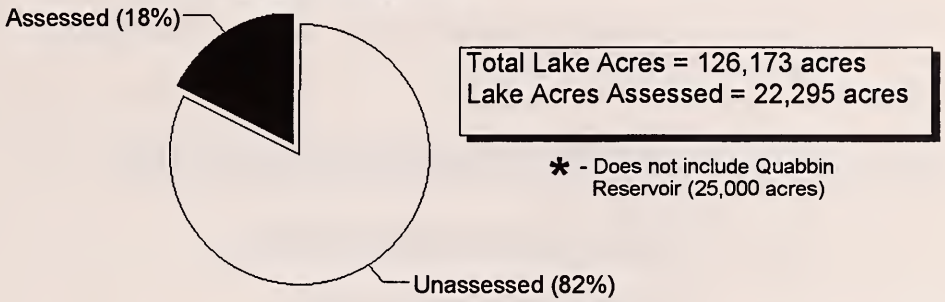
Major Impact Moderate/Minor Impact

** -River Miles Assessed = 1,425 miles

Figure 3

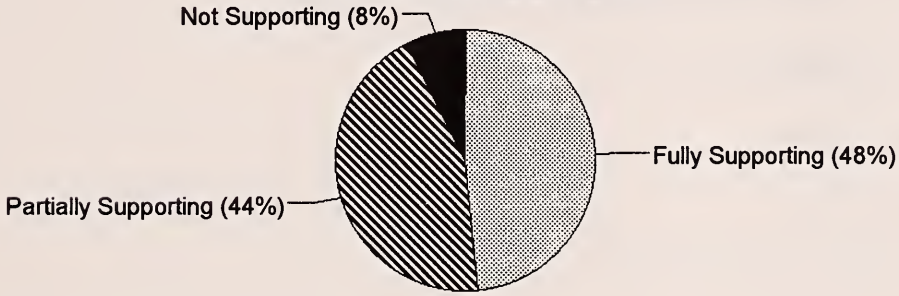
Lake Assessment*

Lake Acres Assessed


Assessed (18%)
Unassessed (82%)
Total Lake Acres = 126,173 acres
Lake Acres Assessed = 22,295 acres
* - Does not include Quabbin Reservoir (25,000 acres)

Level of Overall Use Support

(Percent Assessed Lake Acres)

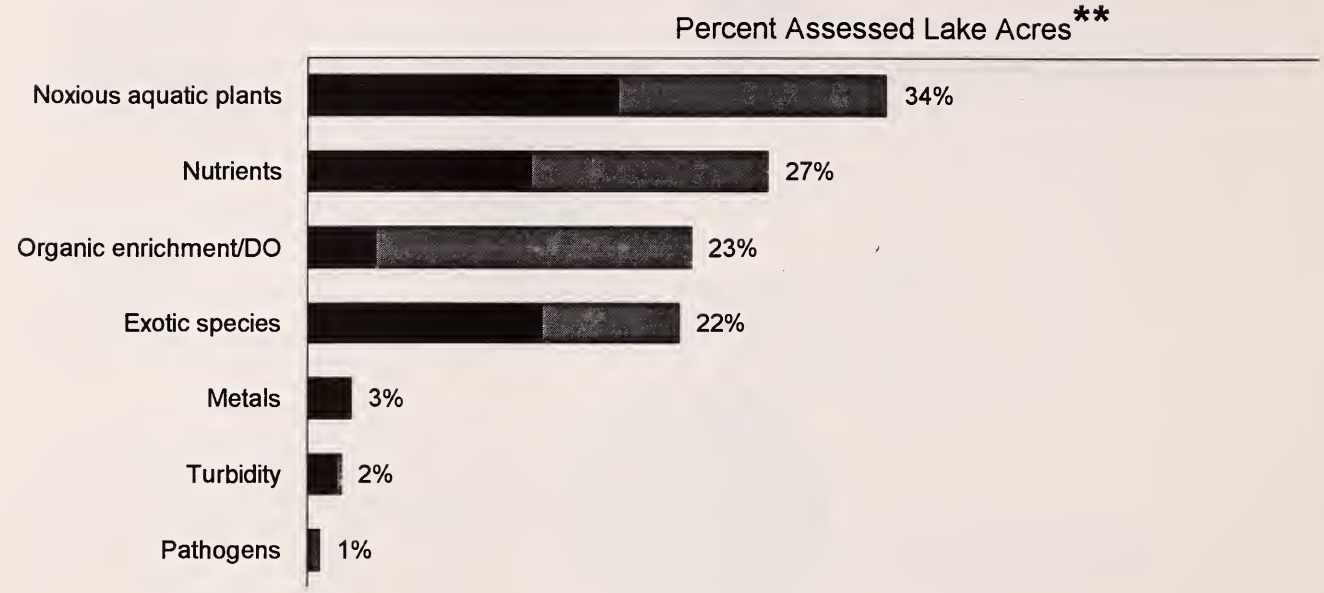


Percent Assessed Lake Acres

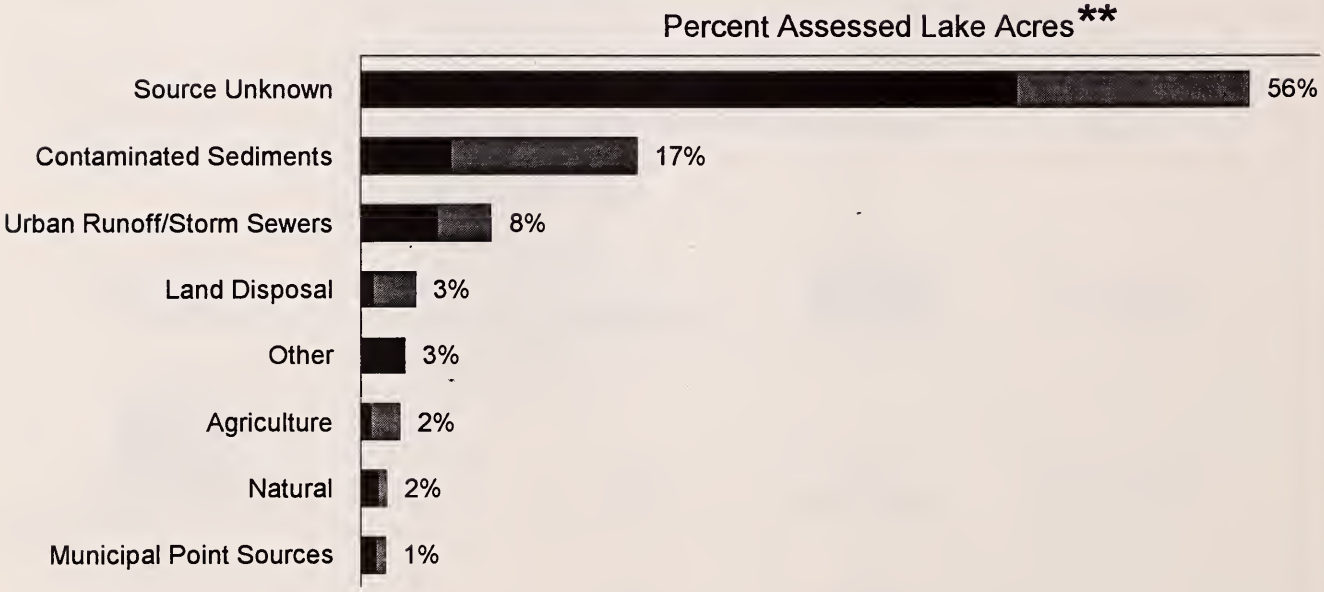
Individual Use	Fully Supporting	Partially Supporting	Not Supporting	Not Rated
Aquatic Life Support	53%	18%	3%	26%
Fish Consumption	7%	0%	3%	90%
Primary Contact-Swimming	60%	35%	5%	1%
Secondary Contact	67%	28%	1%	4%

Figure 4
Lake Assessment*

Pollutants/Causes of Non-Support



Sources of Non-Support

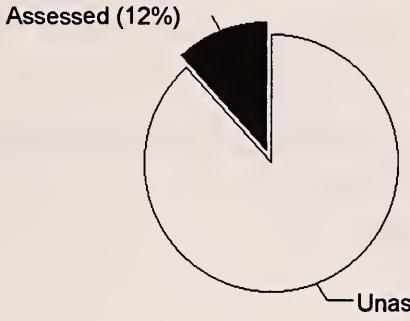


Major Impact Moderate/Minor Impact

*-Does not include Quabbin Reservoir
**-Lake Acres Assessed = 22,295 acres

Figure 5
Marine Waters Assessment

* Marine Waters Assessed, sq miles

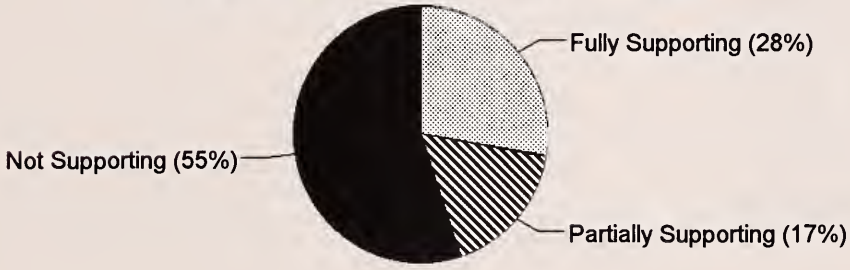


Total Marine Waters = 1,876 sq miles
Total Assessed = 220 sq miles

* - Relative comparison based on estimate of total marine waters using Division of Marine Fisheries shellfish management areas (see text for explaination)

Level of Overall Use Support

(Percent Assessed Marine Waters, sq miles)

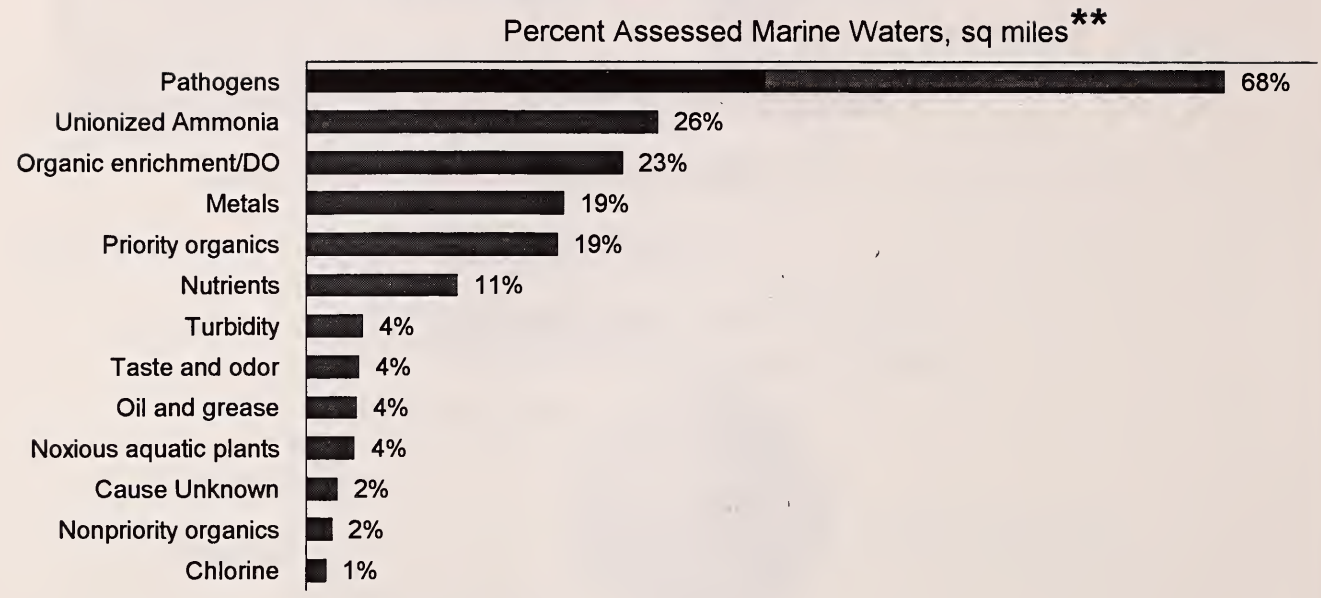


Percent Assessed Marine Waters, sq miles

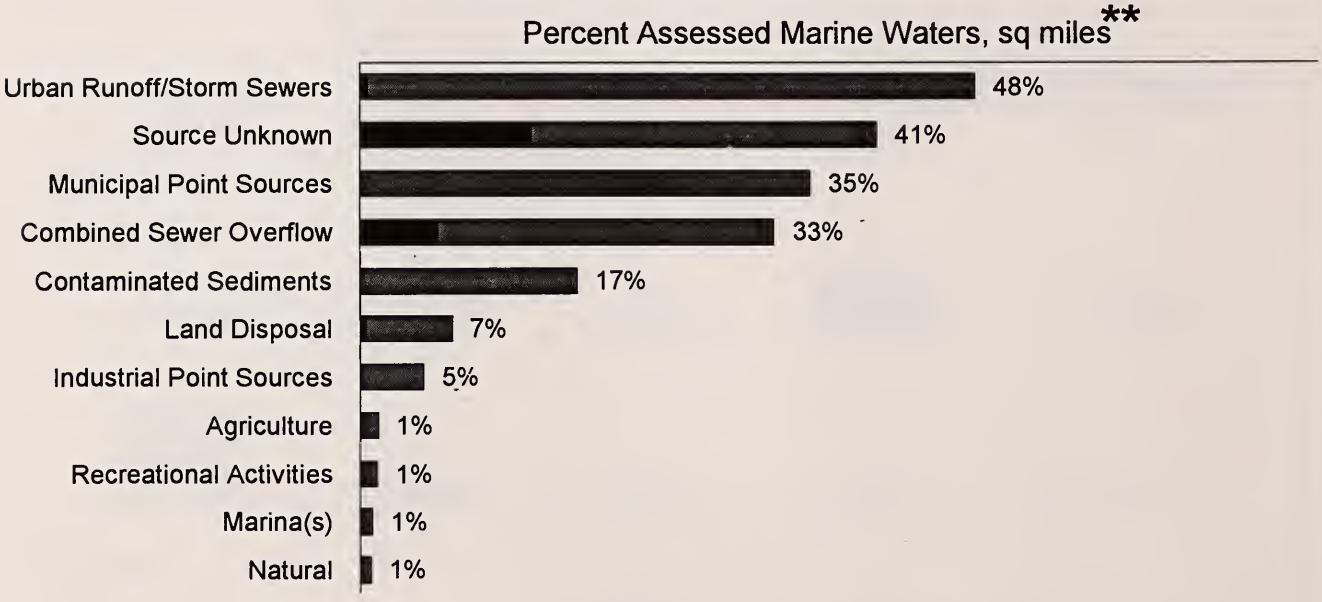
Individual Use	Fully Supporting	Partially Supporting	Not Supporting	Not Rated
Aquatic Life Support	49%	12%	29%	10%
Fish Consumption	4%	0%	21%	75%
Primary Contact-Swimming	44%	43%	10%	3%
Secondary Contact	84%	5%	5%	6%

Figure 6
Marine Waters Assessment

Pollutants/Causes of Non-Support



Sources of Non-Support



** -Marine Waters Assessed = 220 sq miles

2.0 BACKGROUND INFORMATION

2.1 Water Resources[1]

The Commonwealth of Massachusetts has the largest population of the six New England States with over six million people. More than 75 percent of the population resides in the eastern one-third of the state. Precipitation averages about 45 inches per year and is fairly evenly distributed through the state. Average annual evaporation of free water surfaces ranges from about 26 inches in Western Massachusetts to about 28 inches in the eastern half of the State. Yearly runoff ranges from about 20 inches in Cape Cod to about 32 inches in the northwestern corner of the State. The lowest runoff generally occurs during July, August and September. Runoff is highest in March in the eastern sections of the state and highest in April in the western sections and at higher elevations.

The geology of the state is divided into two provinces: the Coastal Plain and the New England Upland. Cape Cod and the Islands form the coastal plain and consist of low hills and plains covering unconsolidated sediments which form the most productive aquifers in the State. The New England Upland province consists of till and stratified drift above metamorphic and igneous rocks, and provides small productive aquifers. Groundwater is used for water supply in small communities and almost exclusively on Cape Cod and the Islands. Surface water is the major source of water supply for all the major urban areas in the state, since no other source is capable of meeting these demands. Surface water in the state is relatively plentiful, and of high quality, but not distributed in proportion to the distribution of the population. Two thirds of the people in the State depend upon surface water for their needs. The Metropolitan District Commission supplies communities in the Greater Boston area (about half the state usage of surface water) from reservoirs in the Chicopee and Nashua River basins.

Offstream water use is estimated at 2,500 million gallons per day (MGD) of freshwater withdrawals from surface and groundwater. Nearly 85 percent of this is surface water. Of these surface waters 71 percent is industrial self-supplied withdrawals (1,500 MGD) and 29 percent is public supply withdrawals (610 MGD). Agricultural uses (irrigation and livestock supply) comprise less than 1 percent of this total. In-stream use for hydroelectric power is estimated at 25,000 MGD.

Table 2.1 provides general water resources information for the State.

2.2 Classification of Surface Waters

The Massachusetts Surface Water Quality Standards (314 CMR 4.00) define six water use classes for surface waters: A, B and C for inland waters and SA, SB and SC for coastal and marine waters. Each class designates multiple water uses for which the water quality shall be suitable. These uses are considered to be the most stringent or governing water uses. Waters may be suitable for other (unspecified) beneficial uses to the extent they are compatible with the designated uses. Table 2.2 summarizes the designated uses for each class.

Certain waters are designated for special protection under the antidegradation provision of the regulations. These restrict or prohibit the authorization of wastewater discharges to critical resources. Most noteable is the "Outstanding Resource Water" designation. This is a nondegradation designation that applies to all Class A waters and certain Class B, Class SA and Class SB waters. A comprehensive listing of Outstanding Resource Waters was published by the Department in July of 1993 and will be updated periodically. Inland waters are subcategorized as to fishery type (cold water fishery, warm water fishery and aquatic life) based on the waterbody's natural potential to support these uses. These subcategories determine the specific dissolved oxygen and temperature criteria to be applied.

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[1] Source: Gadoury and Wandle (1986).

The standards contain tables and maps that list and classify the more prominent waters of the state. Waters not specifically listed in these tables and maps are designated by the regulations as Class B for inland water and Class SA for coastal and marine waters. In addition, certain wetlands certified by the Department of Fisheries and Wildlife as vernal pools are designated for nondegradation (Outstanding Resource Waters).

All waters within the jurisdiction of the state are classified including, without limitation, rivers, streams, lakes, ponds, springs, impoundments, estuaries, wetlands, coastal waters and vernal pools. Separate regulations (314 CMR 6.00) classify groundwater.

The water quality standards were most recently revised on July 20, 1990. The highlights of this revision included:

1) Formal adoption of criteria for toxic pollutants in accordance with EPA's national guidelines for priority pollutants pursuant to Section 307(a) of the Federal Clean Water Act (CWA);

2) Adoption of a CSO policy for waters impacted by Combined Sewer Overflows and provision for a partial use subcategory where it is determined not feasible to completely eliminate impacts;

3) Adoption of a toxic pollutant policy which includes whole effluent toxicity limits for effluents, testing requirements, mixing zone limitations, and chlorination practices;

4) The designation of Outstanding Resource Waters to all Class A (public water supplies and their tributaries) waters, all vernal pools, and many other preservation areas such as certain Areas of Critical Environmental Concern and national parks;

5) The revision of dissolved oxygen and temperature criteria for each classification, including minimum concentrations and percent saturations to protect waterbodies year round through their natural cycles.

TABLE 2.1

SURFACE WATER ATLAS

General[1]	
State Population	6,016,425
State Surface Area (Land) mi^2	7,824
State Surface Area (Water) mi^2	460
Rivers[2]	
Major Drainage Systems	9
Number of Sub-Basins	32
Interstate Sub-Basins	12
Total River Miles*	8,228.8
Number of Named Streams (subset)*	2,002
Miles of Named Streams (subset)*	5,460
Lakes	
Number of Lakes and Ponds[6]	3,191
Area of Lakes and Ponds (acres)[3]	151,173
Coastal Waters[4]	
Area of Harbors and Estuaries (mi^2)	223.08
Total Coastal Miles	1,519
Wetlands[5]	
Total Area of Wetlands (acres)	588,486
Marine and Estuarine Wetlands (acres)	118,000
Freshwater Wetlands (acres)	470,486

Sources:

[1] Miser 1992
[2] Halliwell, et. al., 1982 and River Miles 1993
[3] Ackerman, 1989
[4] Gil, 1985 and Maietta, 1984
[5] Tiner, 1989
[6] Mass GIS 1:100,000 (DLG) by USGS

TABLE 2.2

WATER USE CLASSES

WATER USE/CLASS	INLAND WATERS A	INLAND WATERS B	INLAND WATERS C	COASTAL & MARINE WATERS SA	COASTAL & MARINE WATERS SB	COASTAL & MARINE WATERS SC
1. Fish Consumption	x	x	x	x	x	x
2. Shellfishing	-	-	-	(x)	(x)[1]	-
3. Aquatic Life	x[2]	x[2]	x	x	x	x
4. Primary Contact Recreation	x	x	-	x	x	-
5. Secondary Contact Recreation	x	x	x	x	x	x
6. Aesthetics	x	x	x	x	x	x
7. Public Water Supply	x	-	-	-	-	-
8. Nondegradation	x	(x)	-	(x)	(x)	-
9. Agricultural Supply	-	x	x	-	-	-
10. Industrial Supply	-	x	x	-	-	x
11. Treated Public Supply	-	(x)	-	-	-	-

x - designated use
(x) - in specifically designated segments

[1] - Restricted Shellfish Areas
[2] - Subclasses for cold water, warm water fisheries and aquatic life

3.0 SURFACE WATER ASSESSMENT

3.1 Surface Water Monitoring Program

Surface water monitoring and assessment activities of the Department's Bureau of Resource Protection are performed by personnel of both the Division of Water Pollution Control (lakes and coastal waters), and the new Office of Watershed Management (rivers and streams), established in 1993 to provide the institutional framework for watershed - oriented resource assessment and water quality management (see Section 5.5). A brief description of the monitoring programs is presented below, and a list of surveys conducted during 1992 and 1993 is provided in Table 3.1.

3.1.1 River Water Quality Monitoring

A rotating basin planning approach has been adopted whereby river monitoring activities are conducted in each river basin at five-year intervals to support the NPDES wastewater discharge permit program, water withdrawal permitting mandated by the Massachusetts Water Management Act (WMA), and the nonpoint source pollution control program. Historically, river surveys were typically performed during low-flow, dry-weather conditions which generally represented the worst-case scenario with respect to the assessment of impacts of receiving water quality from point discharges. Today, increased attention is focussed on the identification and control of nonpoint pollution and survey methods are changing to reflect this shift in emphasis. For example, wet-weather sampling may provide the most reliable information pertaining to nonpoint pollutant loadings from stormwater runoff, and, when compared with dry-weather survey data, may further distinguish the effects of point and nonpoint pollution sources. In addition, biomonitoring techniques, which integrate instream conditions over time, represent a sound alternative to wet-weather chemical sampling when evaluating nonpoint sources of pollution, particularly in those watersheds where point discharges do not occur.

River monitoring surveys generally include all or a subset of the components listed in the table below.

Typical Survey Elements

Type	Parameter
Physical	Flow Temperature Suspended solids pH
Chemical	Dissolved Oxygen BOD Nutrients Chlorides Trace Elements
Biological	Chlorophyll *a* Coliform Bacteria Phytoplankton Benthic Invertebrates Fish
Toxics	Metals Organics

TABLE 3.1

SURFACE WATER SURVEYS

1992 - 1993

BASIN	WATERBODY	SURVEY ELEMENTS[1] WATER QUALITY	RBP[2]	BIOACCUMULATION[3]
Blackstone	Blackstone River	+	-	+
	Mumford River	-	+	-
	Waite Pond	-	-	+
	Manchaug Pond	+	-	-
Buzzards Bay	New Long Pond	+	-	-
Chicopee	Chicopee River	+	-	-
	Ware River	+	-	-
	Quaboag River	+	-	-
	Sevenmile River	+	+	-
	Swift River	-	+	-
	Quaboag Pond	-	-	+
	Quacumquasit Pond	-	-	+
	Browning Pond	+	-	-
	Eames Pond	+	-	-
	Turkey Hill Pond	+	-	-
Cape Cod	Cape Cod Bay	+	-	-
Concord	Assabet River	-	+	-
	Assabet River Reservoir	-	-	+
	Walden Pond	+	-	-
	Whitehall Reservoir	+	-	+
Connecticut	Connecticut River	+	-	-
	Sawmill River	-	+	-
	Amethyst Brook	-	+	-
Deerfield	South Pond	+	-	-
Farmington	Otis Reservoir	+	-	-
French	French River	+	-	-
Hoosic	Hoosic River	-	-	+
Housatonic	Housatonic River	+	+	-
	Konkapot River	+	+	-
	Anthony Brook	+	+	-
	Cady Brook	+	+	-
	Windsor Brook	+	+	-
	Waconah Falls Brook	+	+	-
	Cleveland Brook	+	+	-
	Karner Brook	+	+	-
	Goose Pond	+	-	+
	Upper Goose Pond	+	-	-
	Goose Pond Brook	+	-	-
	Lake Garfield	-	-	+
	Pontoosuc Lake	-	-	+
	Hubbard Brook	+	-	-
Ispwich	Greenwood Creek	+	-	-

TABLE 3.1 (CONTINUED)

SURFACE WATER SURVEYS

1992 - 1993

BASIN	WATERBODY	SURVEY ELEMENTS[1] WATER QUALITY	RBP[2]	BIOACCUMULATION[3]
Merrimack	Newfield Pond	+	-	-
Millers	Otter River	-	+	-
	Lake Denison	+	-	-
	Laurel Lake	+	-	-
Mystic	Unnamed Stream	-	-	+
Narragansett	Runnins River	+	-	-
Nashua	Nashua River	+	+	-
	Whitman River	+	+	-
	Squannacook River	+	+	-
	Nissitissit River	+	+	-
	Counterpane Brook	-	+	-
	Pepperell Pond	-	-	+
Shawsheen	Content Brook	+	-	+
	Long Pond	+	-	+
	Richardson Pond	+	-	+
South Shore	James Brook	+	-	-
	Factory Pond	-	-	+
	Billington Sea	-	-	+
Taunton	Taunton River	+	-	-
	Nemasket River	-	+	-
	Leach Pond	+	-	-
Weymouth/Weir	Sylvan Lake	-	-	+

Notes [1] **Elements included in the survey are denoted by +**
[2] **Rapid Bioassessment Protocols**
[3] **Fish or invertebrate tissue assays**

River stations are located at dams, below wastewater discharges, at tributaries, and in impoundments. These locations are chosen to assess the water quality and effects of pollution sources and natural changes. Surveys are conducted periodically to update old data, and to examine conditions before and after a major upgrading of a treatment plant, the addition of a new discharge, or the implementation of Best Management Practices (BMPs) for controlling nonpoint sources of pollution.

River surveys are sometimes supplemented by wastewater discharge sampling which serves to document pollutant loadings to the river at the time of the survey, and to assess compliance with NPDES discharge permit limits. Once sampling is completed and data are received from the laboratory, results are presented and discussed in technical memoranda or published reports. Results of compliance sampling, coupled with the review of discharge monitoring reports (DMR's) submitted by the permittees, enable Department personnel to prioritize facilities for technical assistance, enforcement action, or permit modification.

3.1.2 Lake Monitoring

The Department's Lakes Water Quality Monitoring Program was formally initiated in the summer of 1974 and was significantly expanded in its scope during most of the 1980s. Toward the end of the 1980s and into this decade lake monitoring efforts have been severely reduced due to diminished resources, including reductions in laboratory and field personnel.

During the more active period in the Department's lake monitoring history limnological sampling was conducted to: a) determine baseline lake conditions, b) monitor post-implementation projects, and c) respond to public concerns about lake problems. For the 1994 survey season sampling is likely to be reduced to biological surveys of the macrophyton communities and limited "in-situ" measurements using metered probes. A few baseline surveys may also be scheduled under special request and there are some ongoing post-implementation monitoring projects that are being conducted by consultants under the Department's oversight and review.

A baseline survey is generally conducted in one day and consists of bathymetric mapping of the lake; physical, chemical and biological sampling of the open water areas, tributary stream(s), and outlet; and a quantitative and qualitative mapping of the aquatic macrophyton community in the lake. The primary purpose of this survey is to estimate lake trophic status and identify any point and nonpoint sources of pollution. The lake is sampled during the summer months when productivity is high.

Post-implementation and post-construction monitoring is generally conducted over a three-year period to evaluate the effectiveness of a lake restoration project. The monitoring program is individually tailored to the specific implementation project.

The reduced "in-situ" surveys now being planned have two primary goals. First, they provide information necessary to make a minimum assessment of lake quality biennially for this report. Second, they will be used to document the spread of several non-native and potentially nuisance aquatic plant species that are known to be present in the Commonwealth.

3.1.3 Coastal Monitoring

The coastal survey component of the Department's Marine Program has evolved to include the following objectives:

1. Provide data to help agency staff make meaningful management decisions related to:

    a. Upgrading wastewater treatment plants and siting treatment plant outfalls;
    b. reviewing/certifying NPDES discharge permits;

c. determining the possible need for requiring "in-situ" monitoring in NPDES permits, and helping design those monitoring programs; and
d. assessing the impacts of hazardous waste sites on coastal water quality.

2. Obtain meaningful data on the quality of the coastal environment in order to:

   a. Meet the Department's legislative mandate to monitor the waters of the Commonwealth, and to the extent that problems are discovered, alert the appropriate sections of the Department that action is needed;
   b. prioritize areas for future, more detailed, studies.

Some approaches that could be used to meet these objectives require the analyses of large numbers of water column samples, and the use of specific laboratory methods for the analysis of salt water. Other approaches involve the analysis of sediments and shellfish tissues for heavy metals, PCBs, and PAHs. Dwindling agency resources have necessitated the shift from water column chemistry-based monitoring to instrumentation-based monitoring. On-board meters (deployed from a 22-foot boat) are used to obtain "in situ" measurements of chlorophyll, dissolved oxygen, temperature, salinity, conductivity, and density. These data can be supplemented with analyses of phytoplankton community structure. A major issue that is addressed with this approach is the potential for impacts due to nutrient enrichment (plankton blooms, shifts in phytoplankton community structure, low dissolved oxygen) such as might result from effluents of wastewater treatment facilities. Instead of measuring nutrients directly, the integrators of nutrient enrichment, i.e., phytoplankton standing crop (or possibly productivity), dissolved oxygen concentrations and percent saturation of dissolved oxygen, and to some extent the phytoplankton community structure, are analyzed. The oceanographic conditions that can exacerbate the affects of nutrient enrichment, such as depth of light penetration and occurrence of stratification (by measuring profiles of salinity, density and temperature within the water column) are also measured.

3.1.4 Biomonitoring

Biomonitoring is an integral component of the watershed-based water quality management program. Its importance is underscored in the "Declaration of Goals and Policy" Section 191 (a) of Public Law 92-500 (1972) which stresses the need to restore the biological integrity of the nation's waters and achieve a water quality which provides for the protection and propagation of aquatic life.

Biomonitoring activities encompass four areas of emphasis: macroinvertebrate rapid assessment, bioaccumulation, toxicity testing, and microbiology. The Department's biologists perform habitat assessments and conduct biological sampling to supplement other water quality monitoring and management programs and make recommendations with regard to the control of toxic effluents and thermal discharges through the NPDES permitting process. A Biomonitoring Program Standard Operating Procedures (SOP) manual documents all field and laboratory methods used while carrying out the various program elements. This manual is updated periodically. More detailed information on each biomonitoring element is presented below.

<u>Assessment of Benthic Macroinvertebrate Communities</u>

Rapid bioassessment protocols (RBPs) are used to monitor the health of benthic macroinvertebrate communities as indicators of pollution impacts. These methods were developed to minimize laboratory time requirements for taxonomic identification and enumeration of benthos. Kick-net samples are collected at sites for upstream/downstream comparisons, comparisons against a regional or surrogate reference, or for long-term trend monitoring at fixed sites. Two different levels of analysis are employed, RBP II or RBP III (Plafkin, et al. 1989), depending on the objectives to be served.

A 100-organism subsample is extracted from the original kick sample in the field (RBP II) or the laboratory (RBP III). Specimens are identified to family (RBP II) or to genus or species level (RBP III); the taxonomic data are then compiled to rank water quality on the basis of a series of metrics including:

1) Taxa richness;
2) modified Family Biotic Index (RBP II), or modified Hilsenhoff Biotic Index (RBP III);
3) functional feeding groups (scrapers/filtering collectors);
4) ratio of the number of EPT individuals to the number of chironomidae individuals;
5) percent contribution by the dominant taxon;
6) EPT index;
7) percent similarity of community structure.

Based on scoring of these metrics three categories of impairment are discerned by the RBP II (nonimpaired, moderately impaired, and severely impaired), while the RBP III distinguishes between four (nonimpaired, slightly impaired, moderately impaired, severely impaired).

The RBPs are conducted at up to 25 sampling sites per year in conjunction with comprehensive water quality surveys. Results are used to supplement traditional physicochemical analyses by demonstrating actual instream impacts of pollutants, as well as assessing ambient water quality and habitat conditions throughout a particular watershed.

Bioaccumulation Assessment

Bioaccumulation assessment comprises the Toxics-in-Fish Monitoring Program aimed primarily at the assessment of human health risk associated with the consumption of potentially contaminated freshwater fish, and special studies whereby invertebrate organisms such as caddisflies or crayfish are assayed for the presence of toxic contaminants as a measure of environmental pollution effects.

The Toxics-in-Fish Monitoring Program is a cooperative effort between four Department offices/divisions (i.e., Watershed Management, Research and Standards, Water Pollution Control, and Environmental Analysis) and the Department of Fisheries, Wildlife, and Environmental Law Enforcement, and the Department of Public Health. Fish tissue monitoring is conducted to assess the levels of toxic contaminants in freshwater fish, identify waterbodies where those levels may impact human health, and identify waters where toxic chemicals may impact fish and other aquatic life. Fish surveys generally have been restricted to waterbodies where wastewater discharge data or previous water quality studies have indicated potential toxic problems. For example, sampling has been performed in areas of industrial and commercial development, or known or suspected hazardous waste disposal sites. Furthermore, in recent years, an attempt has been made to sample up to five waterbodies each year at the request of private citizens. Because of limited resources, human health concerns have received higher priority in the surveys carried out thus far. Therefore, fish tissue analysis has been restricted to edible fish fillets.

Uniform protocols, designed to assure accuracy and prevent cross-contamination of samples, are followed for fish collection, processing and shipping. Fish are taken with electroshocking gear or gill nets. Lengths and weights are measured, and fish are visually examined for tumors, lesions, or other indications of disease. Scale samples or other hard parts (e.g., pectoral spines) are obtained from each sample to determine the approximate age of the fish.

Once at the laboratory, samples may be analyzed for specific toxicants (where a particular source is suspected) or for a broad spectrum of heavy metals, pesticides, or organic chemicals. Laboratory analysis includes chromatography/mass spectrometry.

The use of tissue bioassays to trace the movement of toxic contaminants in the aquatic environment has been explored on a limited basis, as time and resources permit. Caddisfly and crayfish bioassays have been used to identify possible sources of PCB's in the Hoosic River Basin. In coastal waters work has focussed on both heavy metals and organic chemicals (e.g., PCB's, PAH) in blue mussels, and heavy metals in seaweeds such as the brown algae, Fucus sp.

Toxicity Testing

In-house toxicity testing capabilities do not exist in the Department at the present time. However, some ambient water column and sediment toxicity tests are performed, as needed to support river basin monitoring activities, in cooperation with the U.S. EPA New England Regional Laboratory in Lexington, MA. This laboratory conducts standard acute and chronic toxicity tests using both freshwater and marine test organisms, according to U.S. EPA approved methods. In addition, effluent toxicity testing is required as a condition of all major NPDES wastewater permits in force in Massachusetts. Toxicity data are used to assess the impacts of point and nonpoint sources of toxic contamination in surface waters throughout Massachusetts and to formulate recommendations for abating toxic pollution through the NPDES permitting process, toxicity reduction evaluations (TRE's), and other water quality management strategies.

Microbiology Program

Microbiological monitoring includes both the maintenance of a small support laboratory for algal identifications and chlorophyll determinations, and the assessment of bacterial indicators of water pollution. The algal counts and chlorophyll results are measures of primary production and are used to evaluate the trophic status of lakes, ponds, and impoundments. Data from riverine and coastal waters are used to identify those waterbodies subjected to nutrient enrichment and consequent algal and macrophyte growth. Algal indicators of the presence of elevated metals concentrations, nutrient enrichment, or other pollutants are noted.

3.2 Methodology

The Department drew from an extensive data base in order to assess the surface waters of the Commonwealth. During the past 30 years the Department has collected water quality information at over 3,000 locations in the state and published 596 scientific and technical reports comprising over 38,000 pages of water quality analyses. These are summarized in Table 3.2. In addition, the Division has conducted over 100 separate biological studies on macroinvertebrates, fish, bacteria and other aquatic communities.

In addition to its own data base the Department used information supplied by the following sources:

State Agencies

Division of Marine Fisheries
Division of Fisheries and Wildlife
Division of Water Supply
Division of Wetlands and Waterways

Federal Agencies

U.S. Geological Survey
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service

PUBLICATIONS OF THE DIVISION OF WATER POLLUTION CONTROL AND OFFICE OF WATERSHED MANAGEMENT 1962 - 1993

Summary of Report Types

BASIN/DRAINAGE AREA	PERIOD OF RECORD[1]	REPORT CATEGORY A	AB	ABC	AC	B	BC	C	CD	D	E	TOTAL
Hudson Drainage System												
Hoosic River Basin (11)	1965-91	5	4	-	-	6	-	1	1	1	1	19
Housatonic Drainage System												
Housatonic River Basin (21)	1963-92	5	2	-	-	7	-	4	-	2	3	23
Connecticut Drainage System												
Farmington River Basin (31)	1974-89	1	-	-	1	-	-	-	1	-	1	4
Westfield River Basin (32)	1965-90	2	3	1	-	4	-	2	-	1	1	14
Deerfield River Basin (33)	1965-88	2	1	2	-	7	-	2	-	2	-	16
Connecticut River Basin (34)	1966-90	9	1	-	-	5	-	1	-	2	1	19
Millers River Basin (35)	1965-87	6	3	-	-	8	-	2	-	2	1	22
Chicopee River Basin (36)	1966-90	6	2	3	1	4	-	1	-	2	9	28
Thames Drainage System												
Quinebaug River Basin (41)	1968-89	1	1	2	-	-	-	-	-	1	1	6
French River Basin (42)	1975-87	-	-	1	-	-	-	-	-	-	1	2
(French and Quinebaug Basins (41/42))	1963-85	3	3	-	-	5	-	2	-	2	1	16
Narragansett Bay Drainage System												
Blackstone River Basin (51)	1962-89	7	3	-	-	8	-	2	-	2	5	27
Ten Mile River Basin (52)	1964-85	5	3	-	-	5	1	3	-	1	1	19
Mount Hope Bay Drainage System												
Mount Hope Bay (Shore) Drainage Area (61)	1970-75	1	1	-	-	-	-	-	-	-	1	3
Taunton River Basin (62)	1964-89	6	1	3	-	8	-	2	-	4	3	27
Boston Harbor Drainage System												
Mystic River Basin and Coastal Drainage Area (71)	1967-88	5	-	-	1	1	-	1	-	-	2	10
Charles River Basin and Coastal Drainage Area (72)	1967-90	8	2	2	2	7	-	3	-	2	4	30
Neponset River Basin Coastal Drainage Area (73)	1973-86	2	-	1	-	2	-	1	-	-	-	6
Weymouth and Weir River Basins and Coastal Drainage Area (74)	1975-82	1	1	-	-	-	-	-	-	-	1	3
Boston Harbor Drainage System (7)	1969-88	1	6	1	-	5	-	-	-	-	1	14
Merrimack Drainage System												
Nashua River Basin (81)	1968-89	5	3	-	1	5	-	3	-	2	4	23
Concord River Basin (82)	1965-90	7	2	4	-	4	-	3	-	4	8	32
Shawsheen River Basin (83)	1968-89	2	-	-	1	-	-	-	1	-	-	4
Merrimack River Basin and Coastal Drainage Area (84)	1968-90	4	2	4	-	5	-	3	2	1	2	23
Coastal Drainage System												
Parker River Basin and Coastal Drainage Area (91)	1968-84	1	-	-	1	-	-	-	-	-	-	2
Ipswich River Basin and Coastal Drainage Area (92)	1968-90	2	1	1	1	-	-	-	-	1	-	6
(Parker and Ipswich Basins and Coastal Drainage Areas (91/92)	1976-81	1	-	-	-	2	-	-	1	-	1	5
North Shore Coastal Drainage Area (93)	1975-90	5	1	1	-	1	-	-	-	1	-	9
South Shore Coastal Drainage Area (94)	1968-89	2	4	-	1	3	-	2	-	3	1	16
Buzzards Bay Coastal Drainage Area (95)	1971-88	7	-	-	-	5	-	3	-	1	2	18
Cape Cod Coastal Drainage Area (96)	1976-83	-	1	-	-	1	-	1	-	1	3	7
Islands Coastal Drainage Area (97)	1975-88	1	1	-	1	1	-	-	-	1	-	5
Totals		**113**	**52**	**27**	**10**	**109**	**1**	**42**	**6**	**39**	**59**	**458**
Miscellaneous Statewide Publications												**125**
Miscellaneous Regional Publications												**13**
											TOTAL	**596**

[1] Denotes earliest and most recent survey year

Private Consulting Firms

Various Facilities Plans
Massachusetts Clean Lakes Program 628 projects (70 lakes)
Service Contract for Toxicity Testing

Scientific Organizations

Woods Hole Oceanographic Institute
Water Resources Research Center
Massachusetts Institute for Social and Economic Research
Boston Harbor Symposium Abstracts

Other Sources

Various Conservation Commissions (nonpoint source assessment)
Municipal and Industrial NPDES Permit Monitoring Requirements

The assessment uses this information to make a judgement about the degree to which the designated uses of a waterbody are supported. In some cases it is appropriate to make judgements based on information other than monitoring data. This information includes land use patterns, location of sources of pollution, predictive modelling and citizen complaints. Assessments made on these types of information or on monitoring data more than five years old, are considered "evaluated waters". When the use support decision is based principally on current site-specific ambient data the waterbody is considered "monitored waters".

In monitored waters the assessment is made by comparing the data collected with criteria specifically designated in the surface water quality standards. Unfortunately, relatively few criteria have been formally adopted in the regulations. When regulatory criteria are not available the Department uses information periodically published by EPA persuant to Section 304(a) of the Federal Clean Water Act as guidance. Tables 3.3 and 3.4 summarize criteria used to make assessments. While the criteria serve as the basis of judgement, they may be appropriately modified to take account of local conditions. Local conditions considered include actual and projected uses of the water, natural background levels of particular constituents, the presence or absence of sensitive or important species, characteristics of the local biological community, temperature and weather, flow characteristics and synergistic and antagonistic effects of combinations of pollutants.

Each designated water use is assessed as to 1) support; 2) partial support; and 3) non-support. The term "threatened" is used to define a category of waters that fully support their designated uses but may not support those uses in the future because of adverse pollution trends or anticipated sources of pollution.

Section 101(a)(2) of the Federal Clean Water Act states that it is the national goal that wherever attainable water quality shall provide for the protection and progagation of fish, shellfish and wildlife and provide for recreation in and on the water. For the purpose of this report the national goal is reported as four separate uses:

1) fish consumption;
2) aquatic life protection;
3) primary contact recreation; and
4) secondary contact recreation

The use "Shellfishing" is used in this report to denote specifically regulated state commercial and recreational activities. These are considered above and beyond the national goal use of shellfish protection which is included in the use "aquatic life protection."

TABLE 3.3

GUIDELINES FOR USE SUPPORT DETERMINATIONS

INLAND WATERS

WATER USE	PARAMETER	A	B	C
1. Fish Consumption	Advisory Data	Support - No advisories/bans in effect Partial - Restricted consumption or subpopulation risk Non Support - "No consumption" advisory or ban in effect		
2. Aquatic Life	Dissolved Oxygen	6.0 mg/l min. ≥ 75% saturation Δ 1.5 mg/l	COLD 6.0 mg/l min. ≥ 75% saturation Δ 1.5 mg/l WARM 5.0 mg/l min. ≥ 60% saturation Δ 2.5 mg/l	5.0 mg/l 24 hr. ave. 3.0 mg/l min. ≥ 50% saturation
	Temperature	COLD 68°F max. Δ 1.5°F WARM 83°F max. Δ 1.5°F	COLD 60°F max. Δ 3°F WARM 83°F max. Δ 3°F Lakes Δ 5°F Streams	85°F max. Δ 5°F
	pH	6.5 - 8.3 units Δ 0.5 units	6.5 - 8.3 units Δ 0.5 units	6.5 - 9.0 units Δ 1.0 unit
	Ammonia-N	0.5 mg/l	pH wint. summ. <7.5 2.0 mg/l 1.5 mg/l ≥7.5 1.0 mg/l 0.5 mg/l	2.0 mg/l winter 1.0 mg/l summer
	Chlorine (TRC)	0.005 mg/l	Cold 0.005 mg/l Warm 0.02 mg/l	None Toxic

GUIDELINES FOR USE SUPPORT DETERMINATIONS (Continued)

INLAND WATERS

WATER USE	PARAMETER	A	B	C
2. Aquatic Life (Cont.)	Whole Effluent Toxicity	0.01 T.U. ave. 0.05 T.U. max.	0.05 T.U. ave. 0.1 T.U. max.	0.1 T.U. ave. 0.3 T.U. max.
	Metals, Pesticides, Other Inorg. & Org.	Drinking Water MCL's Gold Book	Gold Book	Gold Book
	Biocommunity Analysis	Support - No significant community modification Partial - Some modification but generally viable Non Support - Adverse modification		
3. Primary Contact Recreation	Fecal Coliform	200/100ml geo. mean 10% ≤ 400/100ml	200/100ml geo. mean 10% ≤ 400/100ml	--
4. Secondary Contact Recreation	Fecal Coliform	1000/100ml geo. mean 10% ≤ 2000/100ml	1000/100ml geo. mean 10% ≤ 200/100ml	1000/100ml 10% ≤ 200/100ml
5. Aesthetics	Total Suspended Solids	▲ 3 mg/l	25 mg/l Max. ▲ 10 mg/l	80 mg/l Max.
	Turbidity	5 NTU Max.	▲ 5 NTU (<50 NTU) ▲ 10% (> 50 NTU)	None objectionable
	Color	15 C.U. Max.	50 C.U. Max. ▲ 10%	None objectionable
	Oil & Grease	None	None detectable	None objectionable
	Taste & Odor	None - Other than Natural	None objectionable	None objectionable

GUIDELINES FOR USE SUPPORT DETERMINATIONS (Continued)

INLAND WATERS

WATER USE	PARAMETER	A	B	C
5. Aesthetics (Cont.)	Phosphate-P	0.03 mg/l (lake) 0.10 mg/l (river)	0.03 mg/l (lake) 0.10 mg/l (river)	No nuisances
	Bottom Deposits	None	None objectionable	None objectionable
6. Public Water Supply	Toxics	Drinking Water MCL's	TREATED Drinking Water MCL's	--
7. Nondegradation	Overall Water Quality	No significant changes from ambient		--
8. Agricultural Supply	--	--	Specific to use: crop irregation, livestock watering	
9. Industrial Supply	--	--	Industry Specific	

Cold - Cold water fishery
Warm - Warm water fishery
Δ - Change from ambient
Summer - June-Sept. (Inland Waters)
Winter - Oct.-May (Inland Waters)
Gold Book - CWA Section 307(a) Pollutants
Treated Water Supply - Where designated

TABLE 3.4

GUIDELINES FOR USE SUPPORT DETERMINATIONS

COASTAL AND MARINE WATERS

WATER USE	PARAMETER	SA	SB	SC
1. Fish Consumption	Advisory Data	Support - No advisories/bans in effect Partial - Restricted consumption or subpopulation risk Non Support - "No consumption" advisory or ban in effect		
2. Shellfishing	Fecal Coliform	14/100ml geo. mean 10% ≤ 43/100ml	88/100ml geo. mean 10% ≤ 260/100ml	--
	Total Coliform	70/100ml geo. mean 10% ≤ 230/100ml	700/100ml geo. mean 10% ≤ 2300/100ml	--
3. Aquatic Life	Dissolved Oxygen	6.0 mg/l min. ≥ 75% saturation Δ 1.5 mg/l	5.0 mg/l in min. ≥ 60% saturation Δ 2.5 mg/l	5.0 mg/l 24 hr. ave. 3.0 mg/l min. ≥ 50% saturation
	Temperature	85°F max. 80°F ave. Δ 1.5°F	85°F max. 80°F ave. Δ 1.5°F summer Δ 4°F winter	85°F max. Δ 5°F
	pH	6.5 - 8.5 units Δ 0.2 units	6.5 - 8.5 units Δ 0.2 units	6.5 - 9.0 units Δ 0.5 units
	Ammonia-N	0.2 mg/l	pH wint. summ. <7.5 2.0 1.0 ≥7.5 0.5 0.25	2.0 mg/l winter 0.5 mg/l summer
	Chlorine (TRC)	0.005 mg/l	0.010 mg/l	None toxic
	Whole Effluent Toxicity	0.05 T.U. ave. 0.1 T.U. max.	0.05 T.U. ave. 0.1 T.U. max.	0.1 T.U. ave. 0.3 T.U. max.

GUIDELINES FOR USE SUPPORT DETERMINATIONS (Continued)

COASTAL AND MARINE WATERS

WATER USE	PARAMETER	SA	SB	SC
3. Aquatic Life (Cont.)	Metals, Pesticides, Other Inorg. & Org.	Gold Brook	Gold Book	Gold Book
	Biocommunity analysis	Support - No significant modification Partial - Some modification but generally viable Non Support - Adverse modification		
4. Primary Contact Recreation	Fecal Coliform	200/100ml geo. mean 10% ≤ 400/100ml	200/100ml geo. mean 10% ≤ 400/100ml	--
5. Secondary Contact Recreation	Fecal Coliform	1000/100ml geo. mean 10% ≤ 2000/100ml	1000/100ml geo. mean 10% ≤ 2000/100ml	1000/100ml geo. mean 10% ≤ 2000/100 ml
6. Aesthetics	Total Suspended Solids	∆ 3 mg/l	25 mg/l max. ∆ 10 mg/l	80 mg/l max.
	Turbidity	No use impairment	∆ 10%	None objectionable
	Color	No use impairment	∆ 10%	None objectionable
	Oil & Grease	None	None detectable	None objectionable
	Taste & Odor	None - Other than Natural	None objectionable	None objectionable
	Phosphate-P	0.05 mg/l	0.10 mg/l	No nuisances
	Bottom Deposits	None	None objectionable	None objectionable

GUIDELINES FOR USE SUPPORT DETERMINATIONS (Continued)

COASTAL AND MARINE WATERS

WATER USE	PARAMETER	SA	SB	SC
7. Nondegradation	Overall Water Quality	No significant change from ambient		--
8. Industrial Supply	--	--	--	Industry specific

Δ - Change from ambient
Summer - July-Sept. (Coastal and Marine Waters)
Winter - Oct.-June (Coastal and Marine Waters)
Gold Book - CWA Section 307(a) Pollutants

The national goal uses are assessed independently in the following manner:

1) Fish Consumption: The use is supported when their are no fish advisories or bans in effect. Waters partially support the use when a "restricted consumption" fish advisory or ban is in effect for the general population or a subpopulation that could be at potentially greater risk (e.g., pregnant women, children). Restricted consumption is defined as limits on the number of meals consumed per unit time for one or more fish species. The use is not supported when there is a "no consumption" advisory or ban in effect for the general population or a subpopulation for one or more fish species; or there is a commercial fishing ban in effect.

2) Aquatic Life Protection - Chemical data, toxicity tests and biosurvey results are used to make this assessment. The nature, frequency and precision of the Department's data collection techniques dictate that a weight of evidence be used to make the assessment with biosurvey results used as the final arbitor of borderline cases. The use is supported when at the data available clearly indicates support. Minor excursions from chemical criteria may be tolerated if the biosurvey results demonstrate support. The use is partially supported when there is uncertainty about support in the chemical or toxicity testing data; or there is some adverse modification of the biological community. The use is not supported when there are frequent or severe violations of chemical criteria; or there is a severe adverse modification of the biological community.

3) Primary Contact Recreation - The use is supported when bacterial criteria are met and there are no overriding aesthetic considerations that preclude the use. The use is partially met when bacterial criteria are exceeded on an intermittent basis that is neither frequent or prolonged or there are marginal aesthetic violations. The use is not supported if there are frequent or prolonged violations of criteria, where there are formal bathing area closures or where there are severe overriding aesthetic considerations that preclude the use.

4) Secondary Contact Recreation - The use is supported if bacterial guidance is met and there are no overriding aesthetic considerations that preclude the use. The use is partially supported if bacterial guidance is exceeded on an intermittent basis that is neither frequent or prolonged or there are marginal aesthetic considerations that may preclude the use. The use is not supported when bacterial guidance is exceeded frequently or for prolonged periods or where severe aesthetic violations preclude the use.

In addition to the four national goal uses the state designates seven other uses in various waters as noted in Table 2.2. Waters are assessed for multiple uses as follows:

Support: all uses are fully supported.

Partial Support: one or more uses are partially support and the remaining uses are fully supported.

Non-Support: one or more uses are not supported.

3.3 River Assessment

DEP has maintained a fixed monitoring network for rivers over the last 20 years. The network covers approximately 20% of the total river miles in the State. It encompasses all known point sources of pollution, all major urban areas, and other areas where there are suspected sources of pollution. It includes each of the principal rivers in the State. It does not include many minor tributaries

and small headwater streams with no known sources of pollution. From a point source perspective these streams could be evaluated as supporting their uses. However, the contribution of nonpoint source pollution is unknown and therefore these numerous tributaries remain assessed.

The rivers that are included in the monitoring network generally did not support their uses 20 years ago, many of these rivers were grossly polluted. Therefore, the assessments in this report monitor the progress of pollution abatement activities on these major rivers.

3.3.1 Overall Use Support

Table 3.5 summarizes the overall use support for assessed waters. A total of 1425.15 miles were assessed; a number comparable with the 1992 assessment. The high proportion of river miles evaluated reflects a decreased monitoring effort. This trend is expected to continue as the state's monitoring resource continue to decline.

Full support was assessed for 451 river miles or approximately 32% of the total assessed. This number has decreased from 40% in the 1992 assessment. This is not believed to indicate an increase in pollution but, rather, more sophisticated monitoring techniques are detecting more subtle forms of pollution. More widespread toxic monitoring, especially in fish flesh and sediments, have uncovered levels of residual toxicity that prevent streams from supporting their uses. Additional monitoring during "wet weather" events has detected nonpoint source pollution to streams that were previously undetected at the traditionally monitored low flow conditions.

A large portion (39%) of the waters supporting their uses are considered threatened. The primary reason for this is that a number of rivers in central Massachusetts exhibit low pH values indicative of a potential problem with acid precipitation. To a lesser extent, streams that receive toxic effluents are considered threatened when in-stream toxicity data is unavailable.

Approximately 18% of the rivers assessed partially supported their uses and 50% of the rivers did not support one of more of their uses. Remembering that the rivers assessed in this report were grossly polluted two decades ago, the assessment demonstrates that half of these rivers are now relatively clean. The remaining problems are detailed below.

3.3.2 Assessment of Individual Uses

Table 3.6 summarizes individual use support for rivers. The term "not rated" refers to those water assessed for overall use support but not rated for a particular individual use. The first five uses apply to all rivers; the last three uses are specific designations that apply to only some rivers.

Seventy percent of the river miles assessed support the aquatic life use. The aquatic life use carries criteria that are often many times more stringent than drinking water criteria. This statistic demonstrates one of the most dramatic improvements in water quality. Only a small percentage of these waters were suitable for aquatic life 20 years ago. Further validity is given to this number because in a majority of cases the assessments were made on actual biological data which is the most accurate indicator of use support.

Fish consumption is not assessed on a routine basis. Analysis of fish flesh for toxic contaminates is selectively done, targeting areas of known or suspected problems. No information was available on 49% of the rivers assessed. Fish consumption was supported in 22% of the river miles assessed. As noted, this subsample is heavily biased toward areas of known contamination. The numbers are further inflated by the fact that large portions of rivers are often placed under an advisory on the basis of a few sampling sites. The conservative assumptions used to protect the public health makes the assessment of this use dissimilar from the assessment of other uses.

TABLE 3.5

OVERALL USE SUPPORT

1994 ASSESSMENT

DEGREE OF USE SUPPORT	ASSESSMENT CATEGORY EVALUATED	MONITORED	ASSESSED
A. River (miles)			
Full Support	140.95	182.55	323.50
Threatened	27.30	100.20	127.50
Partial Support	80.35	180.65	261.00
Non-Support	240.00	473.15	713.15
TOTAL	**488.60**	**936.55**	**1,425.15**
B. Lakes (acres)*			
Full Support	2,851.00	1,567.80	4,418.80
Threatened	4,255.50	2,107.80	6,363.30
Partial Support	5,799.90	4,010.70	9,810.60
Non-Support	1,404.20	282.00	1,686.20
Not Attainable	16.00	0.00	16.00
TOTAL	**14,326.60**	**7,968.30**	**22,294.90**
C. Marine Waters (sq. mi.)			
Full Support	58.41	1.02	59.43
Threatened	1.19	0.63	1.82
Partial Support	32.52	5.06	37.58
Non-Support	46.01	75.22	121.23
TOTAL	**138.13**	**81.93**	**220.06**

*** Not including Quabbin Reservoir**

TABLE 3.6

RIVER ASSESSMENT

INDIVIDUAL USE SUPPORT
(miles)

USE	SUPPORT	THREATENED	PARTIAL SUPPORT	NON SUPPORT	NOT RATED
1. Aquatic Life	821.20	177.10	150.90	211.35	64.60
2. Fish Consumption	402.10	7.60	0.00	314.90	700.55
3. Swimming	539.50	113.10	318.20	365.85	88.50
4. Secondary Contact	1,008.90	33.90	173.00	119.75	89.60
5. Aesthetics	849.90	123.10	269.10	116.05	67.00
6. Drinking Water Supply	40.10	0.00	0.00	11.40	6.60
7. Drinking Water (treated)	30.30	0.00	0.00	0.00	0.00
8. Non-degradation	25.80	24.80	2.80	13.70	0.00

TABLE 3.7

RIVER ASSESSMENT

CAUSES OF NON-SUPPORT

CAUSE CATEGORY	MAJOR IMPACT (miles)	MODERATE/MINOR IMPACT (miles)
Cause Unknown	0.50	0.00
Unknown Toxicity	10.15	33.10
Pesticides	0.00	4.00
Priority Organics	107.30	159.00
Non-priority Organics	0.00	0.40
Metals	53.90	165.00
Unionized Ammonia	0.00	23.50
Chlorine	0.25	10.15
Other inorganics	0.00	0.80
Nutrients	9.00	253.65
pH	23.30	97.30
Siltation	7.40	21.75
Organic Enrichment/DO	34.00	227.60
Salinity/TDS/Chlorides	0.00	17.60
Thermal Modifications	0.00	8.00
Flow Alteration	2.00	2.30
Other Habitat Alterations	0.00	3.40
Pathogens	371.20	313.05
Oil and Grease	0.00	24.70
Taste and Odor	0.00	3.00
Suspended Solids	0.00	95.35
Noxious Aquatic Plants	0.30	39.50
Turbidity	4.10	34.25

TABLE 3.8

RIVER ASSESSMENT

SOURCES OF NON-SUPPORT

SOURCE CATEGORIES	MAJOR IMPACT (miles)	MODERATE/MINOR IMPACT (miles)
Industrial Point Sources	8.20	190.90
Municipal Point Sources	39.55	301.20
Combined Sewer Overflows	114.30	100.76
Agriculture	3.80	75.60
Silviculture	0.00	0.00
Construction	0.00	5.50
Urban Runoff/Storm Sewers	100.80	556.10
Resource Extraction	0.00	10.30
Land Disposal	81.35	163.30
Hydromodification	2.00	2.30
Source Unknown	116.50	72.55
Other	0.00	64.00
Highway Maintenance and Runoff	0.00	10.95
Contaminated Sediments	95.80	159.75
Natural	53.40	130.45
Recreational Activities	0.00	5.15
Upstream Impoundment	0.00	20.80

Swimming was supported in 46% of the assessed miles and partially supported in 22% of the assessed miles. Partial use means violations are neither frequent or prolonged. Therefore, two-thirds of the river miles substantially meet this use. Secondary contact recreation was assessed as supporting or partially supporting in 85% of the river miles assessed.

Aesthetics was assessed for most rivers in the overall assessment. Twenty years ago many of the rivers in Massachusetts were colored with various dyes, and clogged with floating sludge. These gross forms of pollution have largely disappeared. The most common aesthetic problems remaining are blooms of algae or noxious aquatic plants resulting from the overenrichment of waters with nutrients. Only 8 percent of the over 1400 miles assessed did not support this use. Although the analysis is quite subjective it can be concluded that aesthetic impairment is no longer a major problem in Massachusetts waters.

Drinking water supply refers to those rivers that are designated Class A drinking water supplies. Drinking water (treated) refers to Class B rivers that are also used as drinking water supplies after treatment (i.e., portions of the Merrimack and Concord Rivers). Nondegradation refers to those waters that are designated Outstanding Resource Waters. Very few of these waters are included in the assessment because the monitoring program tends to bypass these areas. Water supplies are regulated by the Division of Water Supply and nondegradation waters tend to be high quality waters with little potential from contamination. These uses were assessed when they were encountered but the information is not useful for a state-wide analysis.

3.3.3 Causes and Sources of Non-Support

Table 3.7 lists the causes of non-support and Table 3.8 lists the sources of non-support for the river assessment. The tables distinguish between major impacts and moderate/minor impacts.

The single largest cause of non-support was pathogens which impacted 48% of the river miles assessed. Pathogens were also the largest cause of major impacts. The sources of the pathogens are stormwater runoff and combined sewer overflows. Major impacts from stormwater runoff generally occur in urban areas which also coincide with impacts from combined sewers.

Only 3% of the river miles assessed had major impacts from industrial or municipal point sources, and virtually no municipal or industrial point sources are excluded from the assessment. Moderate and minor impacts still occur from these sources but these impacts are less often caused by conventional pollutants and more often nutrients or toxics.

It is here that the assessment demonstrates the clean up of 1) point sources and 2) conventional pollutants. The clean up is not reflected in overall use support because many of these same rivers have overlapping pathogen problems and therefore still have not achieved full support.

Eight of the cause categories refer to various forms of toxic pollutants (the first eight listed, exclusive of "cause unknown"). When these are added together "toxicity" becomes the second largest cause of non-support on rivers. The toxicity is largely from two categories: priority organics and metals. The priority organics category refers largely to PCB and pesticide contamination in sediments and fish flesh. Metals contamination also occurs largely in sediments. However, stringent metals criteria adopted in the 1990 water quality standards may result in more river miles being assessed as non-supported.

Nutrients and organic enrichment each impacted approximately 18% of the river miles assessed. Nutrients are not fully removed from sewage by secondary treatment commonly employed for municipal waste. Excess nutrients in the stream causes increased plant growth which, in turn, results in dissolved oxygen problems. Although plants produce oxygen during the day by the process of photosynthesis, plant respiration at night can deplete oxygen resources that are

vital to aquatic life. Both the nutrient impacts and organic enrichment impacts are assessed as causing moderate or minor impacts. Stormwater runoff and CSO's also contribute to these problems.

Land disposal, contaminated sediments ("other" category) and natural conditions (other category) are the remaining major sources of use impairment. Land disposal includes such things as landfills, septic tanks and hazardous waste sites. Of these it is estimated that septic tanks impact 13% of the rivers assessed but seldom cause major impacts. Contaminated sediments impact 18% of the rivers assessed 7% of which are considered major impacts. Thirteen percent of the waters are impacted by natural conditions. These include wetland influenced streams (low dissolved oxygen) and areas of naturally low pH. Under Massachusetts regulations these are not considered violations of water quality standards. However, when it occurs it is assessed and reported to EPA.

3.4 Lake Assessment

3.4.1 Overall Use Support

This year's lake assessment includes 64 lakes (32,968 acres) that were monitored and 154 lakes (14,327 acres) that were evaluated. The Department has data on an additional 229 lakes (20,137 acres) on which assessments had been made in prior years, but were not made this year because the data were too old. The reduction in overall assessments reflects a reduction in monitoring resources; the data on some lakes has become too outdated to make accurate assessments on lake/pond conditions. In some cases portions of the database are used while others are not. The result is that not all individual uses are assessed for each waterbody and, thus, the overall use assessment is based on fewer individual use assessments.

One lake, Quabbin Reservoir, accounts for 25,000 acres, or over half of the assessed acreage. This so skews the database that it hampers analysis. Therefore, Quabbin Reservoir is not included in the tables and charts in this report. Quabbin Reservoir supports all its designated uses (aquatic life, primary contact recreation, secondary contact recreation, aesthetics, and public water supply) with one exception. Fish consumption is not supported because levels of mercury in some fish flesh has been recorded above the FDA limit. The source of the mercury is unknown, but under study.

Excepting Quabbin Reservoir, about 48% of the acres assessed supported their uses, about 44% of acres assessed partially supported their uses, and approximately 8% did not support their uses. The large proportion of partial support is due to assessment data that demonstrated impaired support at least part of the time. Most commonly the causes of temporary impairment were low hypolimnetic dissolved oxygen, noxious aquatic plants, exotic plant species or low transparency. The lake monitoring program was originally designed to assess baseline conditions on lakes and add new lakes each year to the database. Longer term studies were conducted on a relatively few lakes based on available funding or priorities. A single sampling date on many lakes makes a full temporal assessment difficult. In addition, the incremental nature of the database generated via these methods is not amenable to trend analysis and none is attempted.

3.4.2 Individual Use Support

Table 3.10 lists the support status for individual uses of lakes. Over 72% of the assessed acres support aquatic life; nearly 60% support primary contact recreation; almost 70% support secondary contact recreation; and about 63% support aesthetics. In many cases a considerable portion of the acres supporting these uses is considered threatened. Although the fish consumption use category recorded the highest non-support rating for an individual category at 29%, it also represents a category that is largely not assessed because of a lack of data.

TABLE 3.9
LAKE ASSESSMENT
CRITERIA FOR USE SUPPORT

STATUS	CRITERIA
Fish Consumption	
Support	- No advisories/bans in effect.
Partial Support	- Restricted consumption or sub-population risk.
Non-support	- (No consumption) advisory or ban in effect.
Aquatic Life	
Support	- Dissolved oxygen ≥ 60% saturation. - No significant community modification.
Partial Support	- Dissolved oxygen ≤ 60% saturation for assessments based on one survey (includes hypolimnion). - Some modification, but generally viable community.
Non-support	- Dissolved oxygen ≤ 60% saturation for multiple surveys over the summer (includes hypolimnion). - Adverse community modification.
Primary Contact Recreation	
Support	- Fecal coliform < 200/100 ml. - Secchi disc transparency > 4 ft. - Cover of macrophytes (emergent, floating, or submerged growing to the surface) < 50% at their maximum extent of growth.
Partial Support	- Fecal coliform ≥ 200/100 ml. for assessments based on one survey. - Secchi disc transparency ≤ 4 ft. for assessments based on one survey. - Cover of macrophytes > 50% at their maximum extent of growth.
Non-support	- Fecal coliform ≥ 200/100 ml. for multiple surveys over the summer. - Secchi disc transparency ≤ 4 ft. for multiple surveys over the summer. - Cover of macrophytes > 75% throughout the summer.

TABLE 3.9 (CONTINUED)

STATUS	CRITERIA
Secondary Contact Recreation	
Support	- Cover of macrophytes (emergent, floating or submerged growing to the surface) < 50% at their maximum extent of growth.
Partial Support	- Cover of macrophytes > 50% at their maximum extent of growth.
Non-support	- Cover of macrophytes > 75% at their maximum extent of growth.
Aesthetics	
Support	- Total phosphorus < 0.03 mg/l (based on epilimnetic samplings).
Partial Support	- Total phosphorus > 0.03 mg/l (based on epilimnetic samplings) for assessments based on one survey.
Non-support	- Total phosphorus > 0.03 mg/l (based on epilimnetic samplings) for multiple surveys over the year.

TABLE 3.10

LAKE ASSESSMENT

INDIVIDUAL USE SUPPORT
(acres)

USE	SUPPORT	THREATENED	PARTIAL SUPPORT	NON SUPPORT	NOT RATED
Aquatic Life	6,566.20	5,344.30	3,993.40	577.00	5,824.00
Fish Consumption	1,351.60	268.00	0.00	672.00	20,003.30
Swimming	8,041.50	5,232.00	7,871.20	1,012.20	138.00
Secondary Contact	8,790.80	6,063.10	6,193.00	263.00	985.00
Aesthetics	4,728.80	3,074.30	3,998.00	637.00	9,855.90

TABLE 3.11

LAKE ASSESSMENT

CAUSES OF NON-SUPPORT

CAUSE CATEGORY	MAJOR IMPACT (acres)	MODERATE/MINOR IMPACT (acres)
Pesticides	0.00	2.00
Priority Organics	0.00	2.00
Nonpriority Organics	102.00	0.00
Metals	572.00	0.00
Nutrients	2950.40	3146.70
Siltation	8.00	62.00
Organic Enrichment/D.O.	892.00	4189.50
Pathogens	0.00	163.40
Suspended Solids	5.90	22.40
Noxious aquatic plants	4104.60	3570.00
Turbidity	385.00	66.00
Exotic Species	3089.80	1831.00

TABLE 3.12

LAKE ASSESSMENT

SOURCES OF NON-SUPPORT

SOURCE CATEGORIES	MAJOR IMPACT (acres)	MODERATE/MINOR IMPACT (acres)
Municipal Point Sources	206.00	124.00
Agriculture	138.70	412.00
Construction	46.00	0.00
Urban Runoff/Storm Sewers	1068.40	752.80
Land Disposal	155.90	604.00
Hydromodification	8.00	0.00
Source Unknown	9147.10	3233.20
Other	617.00	0.00
Contaminated Sediments	1256.00	2596.50
Natural	238.00	123.00
Recreational Activities	84.00	0.00

3.4.3 Causes and Sources of Non-Attainment

Table 3.11 lists the causes of non-attainment and Table 3.12 lists the sources of non-attainment for lakes. In order of importance the major causes of non-attainment are:

	Cause	% Acres Impacted
1.	Noxious aquatic plants	34%
2.	Exotic (plant) species	26%
3.	Nutrients	24%
4.	Organic enrichment/D.O.	23%
5.	Metals	5%
6.	Turbidity	3%
7.	Non-priority organics	1%
8.	Siltation	<1%
9.	Suspended solids	<1%

The major sources of non-attainment are:

	Source	% Acres Impacted
1.	Source unknown	71%
2.	Others	17%
3.	Urban runoff/storm sewers	8%
4.	Municipal point source	2%
5.	Land disposal	1%
6.	Agriculture	1&
7.	Construction	<1%
8.	Hydromodification	<1%

The major cause of non-attainment is noxious aquatic plants. This cause can be combined with exotic plant species to further emphasize the dominance of this problem. Nutrients and organic enrichment point to related and secondary effects of the primary cause. Together these four top causes are indicative of eutrophication. The Commonwealth's lake assessment methods have traditionally been designed to detect these problems and had been successful in doing so. However, realizing reductions in resources for monitoring the Department will be focussing primarily on aquatic plant problems in the immediate future.

Methods for detecting toxic pollutants have not been emphasized. Therefore, the low percentages of impacts due to toxic pollutants is likely attributed more to methodology than lack of impact.

The sources of non-attainment are largely unknown. Again, this is attributed to technique rather than the elusive nature of sources. Lake surveys were designed to classify the trophic status of lakes rather than discover the source of the impacts.

3.4.4 Trophic Status of Lakes

In addition to use support assessments, the Commonwealth assesses the trophic status of lakes. Appendix II summarizes the trophic status of the lakes and ponds that were assessed for this report. In reviewing data for this year's assessment many of the data were determined to be too old to make trophic status or use support assessments. In some cases data were adequate to make some use support assessments but not others (trophic status included). These factors are reflected in trends toward more evaluated vs. monitored lakes and lower overall numbers and acreage assessed. Thus, although nearly 550 lakes and ponds have been surveyed since the Massachusetts lake monitoring program began in 1974, only 210 lakes and ponds were assessed this year.

TROPHIC ASSESSMENT SUMMARY

Assessed Trophic Status	Acres	# of Lakes
Dystrophic	0	0
Hypereutrophic	2,690	42
Eutrophic	10,729	108
Mesotrophic	8,027	56
Oligotrophic	25,313*	4
TOTALS	46,759*	210

Unknown Acres = 151,173 - 46,759* = 104,414
Lakes/Ponds Not Assessed = 2871 - 210 =2661

* Includes the Quabbin Reservoir (25,000 acres)

Historically the Commonwealth, through the Department of Environmental Protection, used a lake/pond classification system that relied on assigning severity points to six (6) parameters (Secchi disk transparency, hypolimnetic dissolved oxygen, epilimnetic total phosphorus, epilimnetic inorganic nitrogen, phytoplankton counts, and aquatic macrophyte density). Unfortunately, this system was inconsistent, particularly in the cases of shallow, macrophyte-dominated lakes and so it is being abandoned. The first step toward revising the assessment/classification process has been taken with the completion of a document by the U.S. Environmental Protection Agency, Environmental Research Laboratory (using EPA Clean Lakes Program lake Water Quality Assessment grant funds) that delineates detail sub-ecoregion maps for Massachusetts. It is anticipated that, once these subregions have been validated, they will become the basis for new procedures that will give a more realistic picture of the Commonwealth's lake quality, trends in eutrophication, use attainability by subregion, and potential for success in future lake management efforts.

In the interim, trophic status assessments for this report are based primarily on best professional evaluation of the data available rather than the old classification system. Since this is essentially the same procedure that was used in the 1990 and 1992 Summary of Water Quality Reports, the assessments are comparable. As in the 1990 and 1992 reports there is a tendency for skewing of data (excluding the Quabbin Reservoir) toward eutrophic and hypereutrophic lakes because older data are more likely to be retained for assessments in these categories, where as those in the mesotrophic and oligotrophic categories are less likely to be retained.

Once again this year the Quabbin Reservoir is included in the assessment. The inclusion of this large, water supply reservoir continues to significantly skew the assessment of acreage toward oligotrophic when, in fact, with so few lakes assessed (only about 7%) it is unrealistic to project the current condition of lake resources statewide.

3.4.5 Restoration Efforts

Federal Clean Lakes Projects

The Commonwealth is mandated by the Federal Water Pollution Act to restore and maintain the chemical, physical and biological integrity of waters within the Commonwealth. Section 314 of the Clean Water Act established policies and procedures by which the Commonwealth may enter into cooperative agreements to restore publicly owned freshwater lakes and ponds and protect them against degradation.

Although funding for four (4) projects terminated in 1993, the Commonwealth's Department of Environmental Protection (DEP) is still administering the final reporting and closeouts of these projects. As a result of state legislation passed in 1992 future responsibility for administration of federal Clean Lakes Program grants will rest with the Department of Environmental Management (DEM).

State Clean Lakes Program

Also as a result of the 1992 legislation, mentioned above, the authority for administration of the state Clean Lakes Program was transferred from the Department to the DEM. The purpose of the program has been to restore, preserve or maintain the Commonwealth's publicly owned lakes and ponds for recreation and enjoyment.

The goals of the program are threefold:

a) To diagnose degraded lakes and ponds and implement, on a priority basis, long-term solutions for the purpose of restoring their water quality. These long-term solutions must be shown to be feasible, cost-effective, and environmentally sound.

b) To diagnose lakes and ponds and implement, on a priority basis, methods for the long-term preservation of their water quality. This long-term preservation program must be shown to be feasible and cost-effective.

c) To provide short-term remedial actions, on a priority basis, that relieve severe problems of nuisance aquatic macrophyton and/or phytoplankton and that maintain water quality conditions adequate for public recreation and enjoyment.

A further description of the program may be found in the Clean Lakes Program Guidelines (revised April 1989). Since fall of 1988 no new funds have been available for this program. However, despite fiscal constraints within the Commonwealth that have led to long delays in reimbursements to municipalities and consultants/contractors, seven (7) projects are continuing to proceed using funds encumbered in previous fiscal years. Administration of these projects is being transferred to the DEM from the Department.

Table 3.13 enumerates the history of project funding under the Clean Lakes Program. Phase I projects are diagnostic/ feasibility studies of lakes aimed at identifying existing and potential pollution problems and recommending cost-effective and feasible solutions. Phase II projects involve the implementation of the Phase I recommendations for long-term restoration and/or preservation of the lake and its watershed. Maintenance projects are short-term remedies for nuisance aquatic vegetation and algal problems.

TABLE 3.13

HISTORY OF THE MASSACHUSETTS CLEAN LAKES PROGRAM
(Number of Projects)

PROJECT TYPE	FY'83	FY'84	FY'85	FY'86	FY'87	FY'88
Phase I	23(23)	21(21)	12(12)	15(15)	13(13)	13(13)
Phase II	6(6)	9(9)	8(6)	20(15)	9(5)	9(9)
Maintenance	2(2)	5(5)	3(3)	3(3)	0	1(1)

NOTE: Numbers in parentheses indicate projects that have been completed or terminated as of 4/1/94.

With the inactivity of the Commonwealth's Clean Lakes Program over the last five years efforts to retard eutrophication have fallen on the federally supported Nonpoint Source Program and on local initiative. Beginning in 1994 the DEM is piloting a new small grant program. This program will provide $10,000 matching (50%) grants for a variety of activities including lake and watershed management and development/enhancement of public recreation/access facilities. However, given the intensity of development in the Commonwealth and the many decades of neglecting the eutrophication problem these limited efforts have had little effect in changing the negative trend over the last few y ears, nor are they likely to have a significant effect in the foreseeable future.

3.4.6 Impaired/Threatened Lakes and CWA Goals

Of the 2871 lakes and ponds in the state, 210 were assessed this year by the Department. Of these lakes (98%) are considered impaired or threatened (i.e., mesotrophic or more enriched status). Dense macrophyte growths (including non-native, invasive plant species) and/or algal blooms, high nutrient levels anoxia (particularly in the hypolimnia) and low transparency are the most common causes of impaired or threatened uses. The impairment of the Quabbin Reservoir acts to skew the overall cause assessment. High levels of mercury in fish tissue analyses there have led to a fishing consumption ban.

Specific sources of pollutants in Massachusetts are largely unassessed or unknown. Where assessments have been made, however, stormwater runoff and "contaminated" sediments (oxygen demand from decomposition of organic sediments) are most commonly noted. Although direct point discharges to lakes are almost nonexistent, data from several impoundment along the Ten Mile River and French River systems indicate that upstream wastewater discharges have had significant impacts on them.

In addition, all available data were assessed in relation to the designated uses and CWA goals. Table 3.9 lists criteria used to make these assessments.

As with other lake assessments in this report the non-support status of the Quabbin Reservoir - because of a fishing ban - skews the overall assessment. Yet, even without the Quabbin Reservoir data the assessment (Table 3.5) clearly indicates that a majority of the lakes in Massachusetts are only partially supporting their designated uses or are threatened.

3.4.7 Acid Deposition Effects on Lakes

Acid Deposition Monitoring

The Massachusetts Department of Fisheries, Wildlife and Environmental Law Enforcement (MDFWELE) uses the following three categories, based on total alkalinity values, to determine a lake's susceptibility to acid inputs.

CATEGORY	TOTAL ALKALINITY ($CaCO_3$)
Vulnerable	>5 - 10 mg/l
Endangered	>2 - ≤ 5 mg/l
Critical	≤2 mg/l

Using these categories as criteria available data were reviewed. When at least one in-lake total alkalinity value fell within the 0-≤ 5 mg/l range the lake was listed as being impacted by high acidity according to the EPA Waterbody System. Those readings ≥ 5-10 mg/l were considered vulnerable to acidity. Readings above 10 mg/l were not considered to be affected. Most of the data collected through the Department's monitoring program were too old to use in making assessments during this reporting cycle. Of only 27 lakes assessed for acidity, six (6) were impacted by high acidity, eleven (11) were vulnerable, and ten (10) were not impacted.

For the 1990 Water Quality Summary Report a database of broader scope was provided from the Acid Rain Monitoring (ARM) Project; a volunteer citizen monitoring program coordinated by the Water Resources Research Center at the University of Massachusetts. That program, which monitored lakes and streams on a quarterly basis, provided information on over 2,000 lakes monitored from 1985 to 1989 (Walk, personal communication, 1990). Their records indicated that 515 fell into the "critical" category, 398 were "endangered," and 432 were considered "vulnerable." More recent data were received from the ARM Project, but not in time to be incorporated into this reporting cycle.

Acid Deposition Mitigation

The Massachusetts Generic Environmental Impact Report, Statewide Liming of Acidified Waters (1985) stresses that "... the addition of ground limestone is the most biologically, socially and economically acceptable method for mitigating this problem (high acidity)." In developing a program to lime affected lakes the MDFWELE developed the following set of nine criteria for selecting lakes to treat:

1) total alkalinity 2 ppm or less;
2) treat only great ponds or waters with a legal public access;
3) dystrophic lakes are excluded from treatment;
4) the lake's retention time must be a year or more;
5) metals concentrations must be below toxic levels;
6) the lake bottom cannot be dominated by mud or organic matter;
7) the mean depth must be eight feet or more and the maximum depth must be eighteen feet or more for a normal dose;
8) all waters must be screened by the Natural Heritage Program for rare and endangered species; and
9) liming must be the most cost-effective treatment.

N.B. -- One exception to these criteria is that waterbodies with "put and take" sport fisheries or fisheries of important genetic stocks may be treated even if they do not meet all of the above criteria.

From 1987 through 1989, the MDFWELE, in conjunction with Living Lakes, Inc., a private corporation, limed five lakes. During 1991 nine lakes were treated or retreated by Living Lakes, Inc., but since then no liming activities have been undertaken by MDFWELE. Future plans for such activities are uncertain.

3.4.8 Toxic Control

As stated in the liming selection criteria, the MDFWELE will not lime a lake if metal concentrations are above toxic levels. To date neither the MDFWELE nor the Department have developed mitigation methods or established plans to control toxics or metals mobilized by high acidity. Both agencies have limited sampling programs to monitor toxics in the environment and these programs are designed to stress the public health concerns of environmental toxics by focussing on locating areas of high concentrations and limiting the discharge of toxics to prevent toxic mobilization. Unfortunately, along with other monitoring programs in the Commonwealth, these efforts have been reduced to a minimal level due to lack of resources.

3.4.9 Toxic Effects on Lakes

Since the major thrust of the Massachusetts Lake Monitoring Program has always focused on nutrient loading and eutrophication, the toxicity assessments have been made utilizing information from other programs; primarily from the Department's Biological Monitoring Program (part of the Office of Watershed Management, OWM), including fish tissue analyses and basinwide health advisories. Toxicity results reported in Section 3.7 have been obtained from these sources.

Eleven (11) lakes are reported in this assessment cycle as having toxicity problems. Of these, six (6) are part of the Ten Mile River system where high levels of lead had been found in fish tissue. Isolated cases of mercury toxicity in fish tissue led to three (3) of the remaining problem sites, including Quabbin Reservoir. The last two (2) cases are a result of elevated dioxin levels at Lake Winthrop, Holliston and Sylvan Lake, Holbrook. The latter also had toxic levels of pesticides recorded. In all of the above cases fishing advisories or bans are in effect.

3.5 Marine Assessment

Marine waters can be divided into harbors, bays, estuaries and open ocean areas. The Department's waterbody system contains 156 segments covering 224.13 square miles of harbors, bay and estuaries. These areas are relatively near-shore and target areas of known pollution.

With one exception, the assessment does not include open ocean areas . The shellfishing use is assessed using information from the Division of Marine Fisheries. These data include 1,876 square miles of marine waters which includes almost all of the waterbody system areas. Therefore the shellfishing use is assessed for a much more extensive area than the remaining uses; but cause and source information is available only for those areas that overlap with the waterbody system.

3.5.1 Use Support, Causes and Sources of Nonsupport

(a) Use Support

Over half (55%) of the assessed marine waters did not support one or more of their uses. This is not representative of the entire Massachusetts coast. Nearly half of the total area assessed is within the Boston Harbor, Buzzards Bay and North Shore drainage areas; which historically have been areas of severe impacts.

Table 3.14 lists individual use support for marine waters. Aquatic life is supported in nearly half (49%) of the assessed waters. Unlike the river assessment much of the analysis relies on water chemistry to make this determination because biological data is unavailable. Primary and secondary contact recreation is supported or partially supported in over 80% of the waters assessed (partial use refers to impairment that is neither frequent or prolonged). Fish consumption is not rated in 77% of the waters assessed but where it was assessed it generally did not support the use. This is attributed to the targeting of the program toward known trouble spots.

The shellfishing use assessment gives a truer picture of the overall quality of the entire Massachusetts Coast. The area assessed is nine times larger than the area used in the other assessments and the shellfishing use demands extremely high quality water to be supported. In this analysis only 8% of the assessed waters did not support the use while 69% supported the use. A large percentage (22%) were not sampled and therefore could not be rated. Given this information, it appears that the waterbody system underestimates use support in relation to open ocean waters.

(b) Causes and Sources of Nonsupport

Causes of Nonsupport are listed in Table 3.15 and Sources of Nonsupport in Table 3.16. Bacterial contamination causes major impacts in one third of the assessed waters and moderate or minor impacts in another third of the waters assessed. Bacteria are the only causes of major impacts in marine waters. The source of the bacteria are combined sewer overflows and stormwater runoff. Stormwater does not produce major impacts but does adversely effect 48% of the waters assessed. Combined sewer overflows cause major impacts in 6% of the waters assessed and moderate/minor impacts

TABLE 3.14

MARINE ASSESSMENT

INDIVIDUAL USE SUPPORT
(square miles)

USE	SUPPORT	THREATENED	PARTIAL SUPPORT	NON SUPPORT	NOT RATED
Aquatic Life	107.30	1.47	25.65	63.37	22.37
Fish Consumption	8.80	0.00	0.00	45.45	165.91
Swimming	97.70	0.10	94.32	21.72	6.32
Secondary Contact	185.22	0.00	11.00	11.59	12.35
Aesthetics	153.58	10.23	27.48	8.29	20.58
Nondegradation (ORW)	8.69	0.00	8.55	3.99	0.00
Shellfishing*	1,294	0.00	26	147	410

* Database from the Division of Marine Fisheries

TABLE 3.15

MARINE ASSESSMENT

CAUSES OF NON-SUPPORT

CAUSE CATEGORY	MAJOR IMPACT (sq. miles)	MODERATE/MINOR IMPACT (sq. miles)
Cause Unknown	0.00	5.00
Priority Organics	0.00	40.95
Nonpriority Organics	0.00	4.10
Metals	0.00	42.02
Unionized Ammonia	0.00	57.47
Chlorine	0.00	3.13
Nutrients	0.00	24.53
Organic Enrichment/D.O.	0.00	51.58
Pathogens	74.93	74.89
Oil and Grease	0.00	8.10
Taste and Odor	0.00	8.60
Noxious Aquatic Plants	0.00	7.81
Turbidity	0.00	9.10

TABLE 3.16

MARINE ASSESSMENT

SOURCES OF NON-SUPPORT

SOURCE CATEGORIES	MAJOR IMPACT (sq. miles)	MODERATE/MINOR IMPACT (sq. miles)
Industrial Point Sources	0.00	10.99
Municipal Point Sources	0.00	77.69
Combined Sewer Overflow	13.31	58.21
Agriculture	0.00	3.14
Urban Runoff/Storm Sewers	1.10	105.08
Land Disposal	0.90	14.93
Marinas	0.00	2.20
Contaminated Sediments	0.00	37.45
Natural	0.00	1.88
Recreational Activities	0.00	3.00
Sources Unknown	29.32	59.84

in another 26%. Some of the sources of bacteria remain unknown. This is sometimes due to the diffuse nature of nonpoint source pollution and sometimes due to the difficulty in determining cause and effect in marine waters.

Toxic pollutants impacted 32% of the assessed marine waters. Approximately half of this problem is due to sediments contaminated with priority organics and metals. The remainder includes metals toxicity and ammonia toxicity in the water column. In addition to the nonpoint sources and CSO's, municipal point sources impact 35% of the waters assessed. The clean up of municipal point sources in marine waters is well underway, but more work is needed to complete the task. Major rehabilitation of the sewerage system in Boston has resulted in fewer overflows of combined sewers and more wastes being treated at the Deer Island plant. Additional improvements including secondary treatment and an extended outfall are under construction.

3.5.2 Eutrophication

In most coastal waters the essential nutrient nitrogen typically limits the growth of aquatic plants (including phytoplankton, epiphyton, macro-algae and submerged aquatic vegetation). Excess inputs of nitrogen from human activities results in many negative impacts to coastal waters, primarily related to the stimulation of excessive plant growth. Increased abundance of phytoplankton can limit the transmission of light reaching eelgrass leaves, resulting in loss of eelgrass beds (that provide habitat for shellfish and other animals). Accumulations of dense layers of macroalgae on the bottom of shallow embayments can exclude shellfish and other invertebrates. Increased plant matter can also result in high respiration at night or in the lower, dark layers of the water column (lowering the concentration of dissolved oxygen); and the decay of plant matter further depletes the dissolved oxygen in water column.

Hypoxia and Anoxia

Hypoxia, the condition in which dissolved oxygen (DO) concentrations are lowered to 3.0 ppm or less, is cause for concern in surface waters because it negatively impacts biological communities, and it can be a precursor to a more serious condition, anoxia, the total loss of DO in the water column.

Anoxia most often occurs in the sediments and along the very bottom of the water column during worst case condition. General water column surveys are not designed to detect this condition, so the fact that anoxic conditions are not often reported does not necessarily imply that they are not occurring. Anoxic conditions have been detected in Mount Hope Bay (part of the Narragansett Bay system) and Waquoit Bay on Cape Cod.

Available data indicate that hypoxic conditions are infrequent, short-lived events in Massachusetts waters. Hypoxia most often occurs in Boston Inner Harbor, but has also been detected in Dorchester Bay, the Neponset River, Mount Hope Bay, Buzzards Bay in New Bedford Outer Harbor, and Waquoit Bay and its tributaries.

Algal Blooms

Algal blooms in Massachusetts coastal waters can be short-lived and quite localized, making their detection difficult in the absence of coastwide intensive monitoring programs. Such blooms, presumably occurring in response to brief nutrient loading incidents such as rainstorms have, however, been observed. Unfortunately, there are longer-lived, and sometimes geographically extensive, bloom conditions that recur each year. A notorious example is the Pilayella bloom that annually fouls the beaches of Nahant Bay and Broad Sound. This bloom constitutes a serious, and apparently growing, aesthetic and recreational problem in these areas. Once confined to parts of Nahant Bay, it has nearly doubled in extent over the last decade and is now inundating all of the beaches in inner

Broad Sound. On the South Shore, Cape Cod and embayments and estuaries of Buzzards Bay, summertime blooms of Ulva and Chodium are regular events. During the Spring of 1992, a dense, widespread bloom of Phaeocystis was reported on the North Shore in the vicinity of Gloucester. For the last several years the occurrence of blooms of various species of algae have been reported off Cape Cod, often resulting in localized aesthetic impacts to beaches. Of the most concern, with regard to public health, are the blooms along the North Shore (and more recently along the South Shore) of the red tide organism Alexandrium fundyense that result in paralytic shellfish poisoning. It should be noted, however, that the cause of the blooms of this organism is not known, and seems to be related more to salinity, temperature, and possibly water column iron concentrations, than simply to nutrient inputs. For this reason it is probably misleading to include a discussion of this phenomenon in a section on nutrient loading.

Nutrient Loadings

Nitrogen enters coastal waters from a wide variety of sources, including point sources such as wastewater treatment plants and industrial discharges, and non-point sources such as combined sewer overflows, residential and agricultural runoff, groundwater flows, and atmospheric deposition. Although the quantification of loadings from all these sources is not an exact science, several attempts have been made to estimate loadings to large segments of the Massachusetts coastal waters: most notably for Massachusetts and Cape Cod Bays (Menzie-Cura, 1991), and for Buzzards Bay (SAIC, 1991). Menzie-Cura indicated that point source discharges account for 43 to 66 percent of the total nitrogen loading, river discharges account for 37 percent, atmospheric deposition accounts for 16 percent, and surface runoff accounts for 11 percent. The report also states that groundwater is an especially important source of nitrogen for the nearshore waters of Cape Cod. In the case of Buzzards Bay, point sources account for an estimated 62 percent, septic systems for 14 percent, atmospheric deposition for 13 percent, agricultural runoff and inputs from cranberry bogs for 5 percent, and lawn fertilizer and runoff from developed land for 6 percent.

3.5.3 Habitat Modification

Massachusetts is estimated to have lost approximately 30 % of the total wetland acreage and 20 % of coastal wetland acreage existing at the time of the colonists. The Massachusetts Audubon Society (1991) reports that another 1,000 acres, or nearly 0.2 % of the state's remaining coastal and inland wetlands are lost annually. Although Massachusetts has enacted the Wetlands Protection Program gaps in this complex regulatory scheme have resulted in continued losses due to development, both public and private, and secondary alterations. It is the cumulative effect of these activities that reduces valuable habitat. The combined effects of habitat encroachment and degraded water and sediment quality stresses all marine organisms, including important commercial species, marine mammals, and the food web on which they depend. Several programs that have the potential to fill gaps in the Wetlands Protection Program, such as the Wetland Conservancy Program and the Wetlands Restoration and Mitigation Bank, will be discussed in detail in Section 3.6 (Wetlands Assessment).

3.5.4 Living Resources

In a summary on resource depletion the Massachusetts Bays Programs 1991 Comprehensive Conservation and Management Plan, or CCMP, (MBP, 1991) states that while habitat loss diminishes both the quantity and quality of coastal and marine resources, direct depletion of resources through overharvest is also of concern in the region. Fishery stocks rebounded temporarily (after enactment of the Magnuson Fishery Conservation and Management Act of 1976, intended to relieve foreign fishing pressures) before an increase in the number of U. S. fishing boats, with sophisticated fishing technologies, strained the fishery again. The CCMP goes on to state that commercial landings of many species in Massachusetts and offshore waters have plummeted to record lows. Massachusetts mimics the New England-wide trend, with haddock landings down 84% since 1978, Yellowtail flounder down 55%, winter flounder 31%, and Atlantic Cod 13 %. Species diversity

and relative abundance have been altered, so there is a significant ecological impact accompanying this economic impact. Sharks, skates, and dogfish have replaced the valuable groundfish, which now comprise less than 50 % of the bottom biomass. Populations of pelagic species (Atlantic bluefin tuna, sharks, and billfish) are also declining due to overfishing and environmental pressures.

3.5.5 National and State Programs

Massachusetts is currently participating in four National Estuaries Programs: Gulf of Maine, Massachusetts and Cape Cod Bays, Buzzards Bay, and Narragansett Bay. The general intent and approach of each of these programs is similar in that they combine local, state, and federal agency resources, with citizen and academic participation, to identify problem areas, investigate and prioritize corrective actions (which might include conducting research and monitoring), fund and initiate corrective projects, and strengthen and focus long-term management efforts aimed at conserving the ecosystems of each of the bays.

3.5.6 A Case Study

The Narragansett Bay system, which includes Mount Hope Bay, receives thermal discharges, municipal and industrial wastes, and non-point source runoff from both Rhode Island and Massachusetts, including a significant annual loading from the combined sewer overflows of the City of Fall River. Historical data on Mount Hope Bay indicated that there were periods of time when the dissolved oxygen concentrations in the lower levels of the water column fell below that permitted by the Massachusetts Water Quality Standards. Given the shallowness of the Bay and the nature of the watershed (i.e., significant source of nutrient loadings) it was considered a likely site for nutrient enrichment and related impacts (including low dissolved oxygen). A large-scale study conducted in 1991 by the Department's Marine Program confirmed low dissolved oxygen events in the Bay.

The results of the two and a half month field monitoring study in Mount Hope Bay indicated that there are infrequent periods during the summer months in which dissolved oxygen concentrations in the bottom waters of the northwestern parts of the bay reach zero (a condition known as anoxia). More frequently, and more widespread, the D.O. concentration reaches 3 mg/l, a condition known as hypoxia, which is extremely harmful to the aquatic biota. Indications are that the excess phytoplankton production, due to nutrient enrichment, is responsible for the dissolved oxygen problems in the bay.

In order to combat the D.O. problem, as well as impacts due to the addition of bacteria to the Bay, a Combined Sewer Overflow (CSO) Facilities Plan was initiated by Fall River. Dry weather overflows were immediately corrected by an intense inspection, repair, and maintenance program performed by the City. The results of studies and modeling of the entire system was a proposal to restructure the sewer system, including the construction of a 20' diameter storage tunnel 4.5 miles in length. The benefits of this proposed action are as follows:

- Storage of combined sewage for a 3-month storm
- 19 CSO locations reduced to 1 "extreme" event overflow location in Mount Hope Bay
- A 75% reduction in CSO volume
- An average of 662 annual CSO events reduced to 4 events per year
- Chlorination/dechlorination and solids/floatables removal of the extreme event overflow.

Although the loadings from the Fall River combined sewer overflows are only a part of the problem, the reductions in loadings to the Bay, that will be achieved by the proposed plan, will result in significant improvements in the water quality of Mount Hope Bay. A major challenge left for local, State, and Federal agencies is to determine remaining sources of pollutants to the system, and develop means of implementing corrective actions. Continued monitoring of the Bay by the Department's Marine Program will be instrumental in determining future conditions resulting from any corrective actions that might be taken.

3.6 Wetlands Assessment

3.6.1 Extent and Utility of Resource

Wetlands are recognized as one of our most valuable natural resources. Wetlands provide many important functions including: filtering pollutants and excess nutrients from surface waters, removing contaminants from ground water, storing flood waters during rain and snow events, and providing valuable habitat to many species of fish and wildlife.

Massachusetts wetlands vary from floodplains along rivers and streams, to beaches, dunes, and barrier beaches along the coast, to freshwater wetlands scattered throughout the state. Types of wetlands include the swamps, bogs, meadows, marshes, fens, beaches, and intertidal areas, found along the coastline and throughout the inland areas of the Commonwealth.

Based on the 1975-1977 National Wetland Inventory (NWI) Maps, the U.S. Fish and Wildlife Service estimates twelve percent (approximately 590,000 acres) of the land area in Massachusetts are wetlands (Tiner, 1989). A breakdown of Massachusetts wetland acreage by specific wetland type is presented in Table 3.17. Major wetland types by county are listed in Table 3.18. The percentage of wetland area in various Massachusetts counties range from 4% in Franklin County to 37% in Nantucket County. Wetlands occupy 20 to 25% of the land areas in the Barnstable, Bristol, Essex, and Plymouth counties; from 10 to 15% of the land area in the counties of Dukes, Middlesex, Norfolk, Suffolk, and Worcester; and about 5% of the land mass in Hampden, Hampshire, and Berkshire counties. In total, about twenty percent of Massachusetts wetlands consist of marine and estuarine environments. Most of the remaining 80% of wetland areas consist of deciduous forested wetlands. About 14,000 acres (2.3%) consist of farmed cranberry bogs.

The preceding analysis of wetland types and acreage is based on aerial photographs collected during 1975-1977. While the NWI maps provide a good baseline for wetland resources, much construction activity and wetland impacts occurred during the 1980's building boom in Massachusetts. In addition to being out of date, the National Wetland Inventory maps are fairly small scale (1:75,000) and miss many wetlands smaller than one acre in size. The Division of Wetlands and Waterways through the Wetlands Conservancy Program has initiated a project to develop larger scale (1:5,000), more detailed, and complete baseline wetland resource information.

Over the next five years, the Wetlands Conservancy Program will map and classify all wetlands in Massachusetts greater than or equal to 1/4 acre in size. To accomplish this task, the Conservancy Program is acquiring orthophotoquads at a 1:5,000 (1"=417') scale and color infrared aerial photographs (CIRs) at a 1:12,000 (1"=1,000') scale. Orthophotos are very accurate multi-purpose basemaps which have a positional accuracy of +/- 10.6 feet. Spring, leaves-off color infrared photographs, in conjunction with photointerpretation and field verification, will be used to delineate and classify wetlands 1/4 acre or larger.

This geographic information will be automated to create a new, statewide hydrography and wetland datalayer for the Massachusetts Geographic Information System (MassGIS). Orthophotos will be used to compile and automate highly accurate locational data for Hazardous Waste (21E) sites and other Department regulated objects. Inexpensive orthophoto wetland maps will be available to the

TABLE 3.17 Massachusetts wetland acreage by type based on the U.S. Fish and Wildlife Service's National Wetlands Inventory. Wetlands are classified according to Cowardin and others (1979) (from Tiner, 1989).

WETLAND TYPE	ACREAGE
Marine Wetlands	
Beach/Bar	23,381
Intertidal Flat	14,303
Rocky Shore and Aquatic Bed	1,049
TOTAL	**38,733**
Estuarine Wetlands	
Emergent (includes 71 acres of Scrub-Shrub)	47,704
Intertidal Flat	29,227
Beach/Bar	2,214
Other Estuarine	122
TOTAL	**79,267**
Palustrine Wetlands	
Open Water and Aquatic Bed (Pond)	23,038
Emergent	24,240
Deciduous Forested	299,497
Evergreen Forested	27,415
Dead Forested (mostly beaver-modified)	2,964
Deciduous Scrub-Shrub	71,928
Evergreen Scrub-Shrub	2,725
Farmed (cranberry bog)	14,194
Other Palustrine	122
TOTAL	**466,123**
Lacustrine Wetlands	
Aquatic Bed	2,501
Emergent	1,291
Other	529
TOTAL	**4,321**
Riverine Wetlands	42
STATE TOTAL	**588,486 ACRES**

TABLE 3.18 County wetland acreage summaries for Massachusetts based on NWI mapping (from Tiner, 1989).

COUNTY	MARINE WETLANDS (acres)	ESTUARINE WETLANDS (acres)	PALUSTRINE WETLANDS (acres)	LACUSTRINE WETLANDS (acres)	RIVERINE WETLANDS (acres)	TOTAL WETLANDS (acres)
Barnstable	20,416	23,113	15,066	50	-	58,645
Berkshire	-	-	29,259	631	2	29,892
Bristol	1,431	6,665	62,079	301	-	70,476
Dukes	1,389	2,012	2,949	51	-	6,401
Essex	3,960	22,762	41,930	106	-	68,758
Franklin	-	-	16,021	452	30	16,503
Hampden	-	-	20,913	91	-	21,004
Hampshire	-	-	17,290	289	10	17,589
Middlesex	-	-	58,004	349	-	58,353
Nantucket	6,625	1,093	3,068	-	-	10,786
Norfolk	54	3,470	29,554	101	-	33,179
Plymouth	3,702	17,615	75,749	413	-	97,479
Suffolk	1,156	2,537	579	-	-	4,272
Worcester	-	-	93,662	1,489	-	95,149
TOTALS	**38,773**	**79,267**	**466,123**	**4,321**	**42**	**588,486**

general public, state agencies, or municipal conservation commissions. Digital Elevation Model data, a byproduct of orthophoto production, will also be made available through MassGIS for hydrologic modelling and surface contour mapping.

Since 1990 the Wetlands Conservancy Program has acquired CIRs for approximately 55% of the state including: Metro/Suburban Boston, Buzzards Bay (West Shore), the MDC watersheds of the Quabbin, Wachusett and Sudbury Reservoirs, the North Shore and Merrimack Valley, Cape Cod and the Islands, and complete coverage of Plymouth County and Bristol County in Southeastern Massachusetts. Orthophotoquads are available for Metro Boston, Buzzards Bay area, and the MDC watersheds. In addition to these areas, both CIRs and Orthophotoquads have been acquired for the Fort Devens complex centered in Ayer, Massachusetts, as part of a hazardous waste cleanup associated with the base transfer process.

For the sixty-three towns with existing orthophoto and CIR coverage, wetland resources have been delineated, classified, and for over thirty towns, fully automated as a GIS database (wetlands delineated, classified and digitized). Preliminary estimates of wetland acreage by wetland type for these towns is presented in Table 3.19. These wetland statistics will be invaluable to update Massachusetts wetland resource inventories. Additionally, this database in conjunction with the DWW's proposed WETINFO permit tracking system will be utilized to quantify wetland losses.

The Wetlands Conservancy Program and the Beaufort(NC) Laboratory of the National Marine Fisheries Service have worked together to develop a comprehensive inventory of the submerged rooted vascular plant habitat resource areas in selected areas of the Massachusetts coast. Pilot project areas included:

Buzzard's Bay (eastern portion),
Nantucket (northern portion),
Annisquam River/Gloucester Harbor, and
Nahant

The project consists of acquisition and interpretation of true negative color aerial (2445) photography at the 1:20,000 scale. In contrast to other types of photointerpretation, extensive fieldwork and groundtruthing is required to accurately delineate and classify the subject habitat resource areas. All fieldwork and photointerpretation was conducted in accordance with methodologies developed through the Coast Watch Change Analysis Program (C-CAP), a component of the National Oceanic and Atmospheric Administration, Coastal Ocean Program.

Submerged rooted aquatic vascular plant (SRVP) habitat in the Pilot project areas have been delineated on acetate overlays. For Buzzard's Bay, the SRVP data will be transferred to digital orthophoto maps previously developed for that area by the Wetlands Conservancy Program. SRVP data will be included in the wetland classification system used by the WCP in its ongoing statewide wetland mapping inventory. As the state's 1:5,000 scale digital orthophoto map series progresses, SRVP data will be included in the WCP wetlands overlay data coverage.

It is projected that SRVP mapping data for the entire coastline of the state could be collected within three years with sufficient funding. Plans for the 1994 season are to survey the area from Boston to Provincetown (possibly including both coasts of Cape Cod).

The WCP will continue its cooperative relationship with the NOAA/NMFS Beaufort Laboratory throughout the duration of the statewide SRVP data capture. Currently, both agencies are working together to evaluate the effectiveness of a submerged video camera to verify the presence of SRVP in areas of deep water and increased turbidity.

Table 3.19 **Preliminary estimates of wetland acreage by wetland type from Wetlands Conservancy Program data for twenty-nine towns in the Metropolitan Boston Area.**

Wetland Type	Acres
Shrub Swamp	511
Hardwood Swamp	3,594
Marsh, Wet Meadow	1,438
Open Water	3,577
Deep Marsh	414
Conifer Swamp	32
Beach	811
Rocky Intertidal Shore	173
Coastal Bank	299
Tidal Flat	636
Salt Marsh	1,319
Dune	29
Mixed Swamp	178
Barrier Beach	757
Bog	6
TOTAL	**13,774**

The Beaufort Laboratory has directed other state mapping efforts to the WCP for information and technical assistance. In late January 1994, WCP hosted with the EPA Region I staff a meeting of SRVP specialists from the region in an effort to coordinate mapping efforts to the protocols being developed and implemented in the Massachusetts cooperative program.

3.6.2 Wetlands Monitoring

The Division of Wetlands and Waterways does not have a statewide wetlands monitoring program in place at this time. Some Orders of Conditions, Superseding Orders of Conditions, or Variances to the Wetlands Protection Act, however, may require project proponents to monitor specific project elements and submit this information to the Division or local conservation commission. For instance, projects which utilize constructed wetlands for stormwater management purposes may be required to provide water quality data. Wetland replication and restoration projects may be included in future monitoring efforts.

Other sources of information on the relative health of wetland resources include: United States Fish and Wildlife Service, the Department's Bureau of Waste Site Cleanup, Bureau of Waste Prevention, and the Office of Watershed Management through water withdrawal permits. The Bureau of Waste Site Cleanup has identified 5,137 Hazardous Waste (21E) sites in Massachusetts as of September 1991 (Federal Superfund sites are included in this count). Information on wetland resources damaged is limited for most 21E sites. More information is available for Superfund Sites but data on resources impacted around both 21E and Superfund sites has not been summarized to date. Field investigations at four Superfund sites indicated that many acres of wetlands have been filled, contaminated, or otherwise impacted by various pollutants. Total wetland acreage severely impacted ranged from 3.7 acres at the Sullivan's Ledge site to over a thousand acres of intertidal and subtidal habitat in New Bedford Harbor. Pollutants identified in degraded wetlands include: organic compounds (PCB's, trichloroethane, benzene, phenanthrene, naphthalene), heavy metals (cadmium, lead, copper, chromium, mercury, silver), arsenic, vanadium, and zinc. Other impacts to wetlands include altered hydrology and excessive sedimentation.

There are approximately 700 landfills in Massachusetts and 250 of these are regulated by the Department. A study by the Bureau of Waste Prevention, Division of Solid Waste which summarized land uses and water resources indicated over 11,500 acres of non-forested wetlands are located within a half mile of the 183 regulated landfills in the study. Total wetland acreage in the half mile zone around landfills was underestimated since only non-forested wetlands from the 1985 MassGIS Land Use Data layer were used in this analysis. Preliminary statistics from the Wetlands Conservancy Program indicate non-forested wetlands may represent only 25% of the total wetland acreage. Resource impacts from landfills may include hydrologic modifications, increased pollutant loadings and excessive sedimentation to wetlands and other water resources. Further effort is required by both state and federal agencies to fully document the extent of impacts to wetlands from 21E sites, Superfund sites, and landfills.

DWW, recognizing the need for a proactive and consistent approach to wetlands monitoring, requested funds from the EPA 104(b)(3) State Wetland Program Development grants to generate a standard operating procedure for collecting wetlands data. An EPA funded project is currently underway to develop a two-tier approach to functional assessment of wetlands. This project, to be completed by Dr. Joseph Larson, University of Massachusetts, by 1995, will provide New England wetland programs with both a broad scale planning and a site-specific approach to the assessment of wetland resources.

3.6.3 Impacts - Cumulative Loss Estimates

The U.S. Environmental Protection Agency estimates approximately 54% of the wetland area in the United States has been destroyed since the country was first colonized by European settlers. Total loss of Massachusetts wetland acreage since colonial times is estimated to be at least twenty-eight percent (28%)

(Dahl, 1990). In Massachusetts, wetlands are frequently proposed to be altered for residential/commercial developments, highway expansions, roadway crossings, farming activities, mosquito control, construction or maintenance of public facilities, and recreational uses. The U.S. Fish and Wildlife Service determined that between 1977 and 1986 over 1300 acres of wetlands in Southeastern Massachusetts were destroyed or converted to other uses (Tiner and Zinni, 1988).

The Department was awarded a 104(b)(3) grant in July 1992 to develop a model to analyze the extent and causes of non-compliance with the Wetlands Protection Act. This project provides a third estimate of wetland loss. Two hundred and seven (207) randomly selected projects in twelve municipalities from DEP's northeast region were reviewed. Twenty-one of these projects which were appealed to the Superseding Order of Conditions (SOC) stage proposed to alter and replicate Bordering Vegetated Wetlands (BVW). For projects that received an SOC, 37,752 sq. ft. of BVW were altered with 46,025 sq. ft. replicated - an increase of 8,273 sq. ft. These same 21 projects as approved at the town level proposed to alter 43,091 sq.ft and replicate 43,985 sq. ft. - a slight increase of 894 sq. ft. Thus, the SOC process resulted in lesser amounts of wetlands filled and more wetland area replicated (Figure 7).

Another thirteen projects which were not appealed and received an Order of Conditions (OOC) at the municipal level also proposed to alter and replicate BVW. At the town level, 25,368 sq. ft. of BVW was altered with 18,965 sq. ft. replicated - a loss of 6,403 sq. ft. Most of this loss of BVW at the town level was due to two approved limited projects which did not require wetland replication. Three different limited projects which were appealed and reviewed at the State level however, showed a net gain of 6,632 sq. ft. of BVW.

Overall the amount of BVW alterations proposed was less than the amount replicated - 63,120 sq. ft. versus 64,990 sq. ft. respectively - a net gain of 1,870 sq. ft.

An estimate of the total bordering vegetated wetland impacts in the Northeast region during 1988 to 1992 was calculated by comparing the amount of wetlands filled or replicated in these randomly selected cases to the total number of NOIs filed. This regional comparison indicated a total of 64.8 acres of BVW were filled and 66.7 acres replicated for an estimated net gain of 1.75 acres of BVW from 1988 to 1992. On an annual basis, 12.9 acres were filled and 13.3 acres replicated for a net gain of 0.4 acres. Expanding this comparison statewide provides estimates of 47.7 acres filled and 49.1 acres replicated per year for a net annual gain of 7.0 acres.

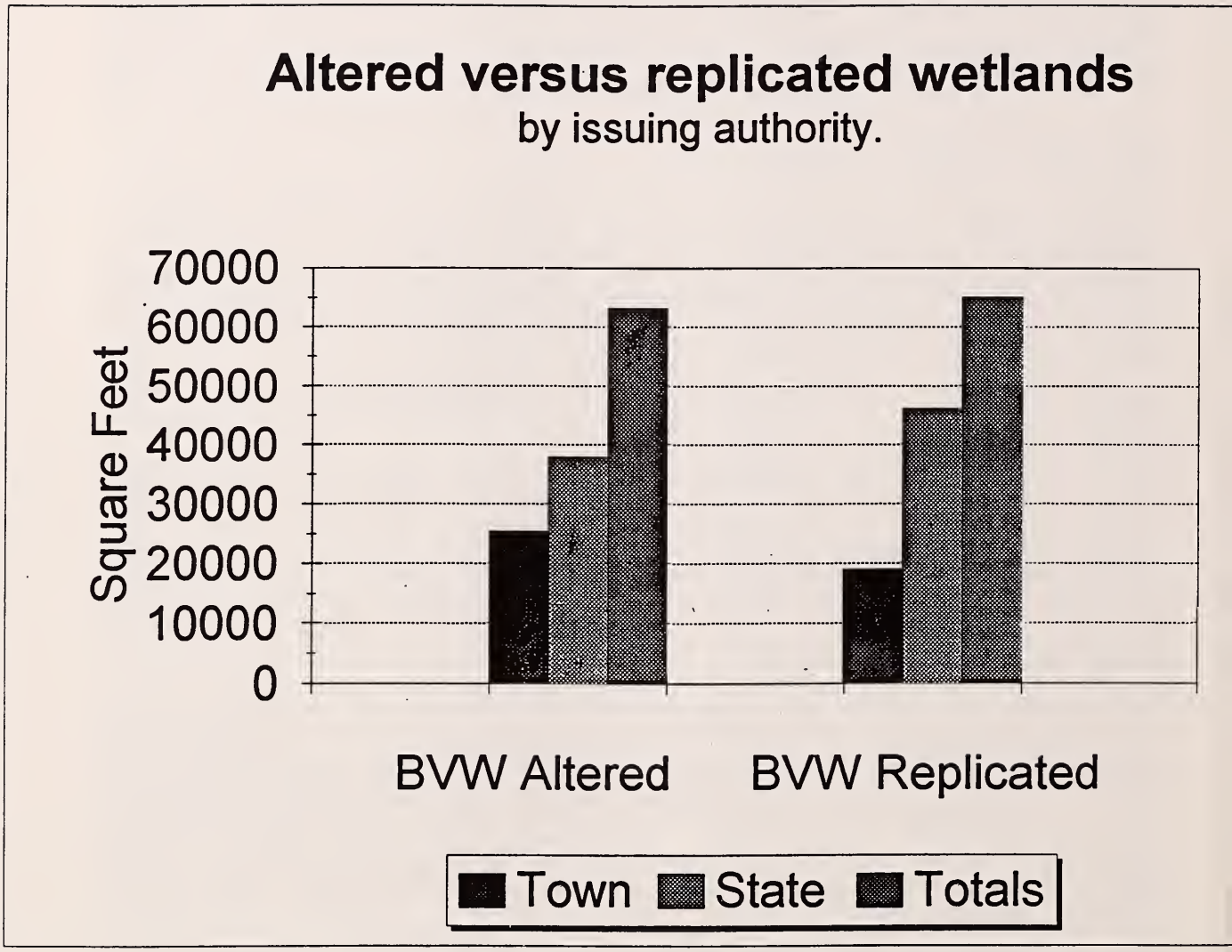
While these calculations and observations from the permit review indicate a "net gain" in Bordering Vegetated Wetlands, the increase is in replicated BVW areas. These replicated BVW areas, however, do not provide the full complement of wetland functions and the failure rate can approach 60% in Massachusetts (ACOE 1989). Additionally, replication rates for other wetland resource areas such as Bank or Bordering Land Subject to Flooding (BLSF) experienced different replication "rates". For instance, in the same group of projects discussed above only 50% of the altered Bank was replicated at the town level; 70% at the State level. Adequate compensatory flood storage for projects which filled BLSF, however, was provided.

Wetland Restoration and Banking Program

To help address wetland losses, the Executive Office of Environmental Affairs (EOEA) is taking steps to initiate a Wetlands Restoration and Banking Program. This program aims to:

- increase the state's diminishing wetlands base;
- initiate a permanent, coordinated program to restore filled and degraded wetlands;
- explore the feasibility of a basinwide approach to wetlands restoration and to wetlands banking; and

Figure 7


Altered versus replicated wetlands
by issuing authority.
Square Feet
70000
60000
50000
40000
30000
20000
10000
0
BVW Altered
BVW Replicated
Town
State
Totals

- further implement the WRC policy goal of no net loss of wetlands in the short term and, especially, a net gain in the long term.

Program start up research to be conducted during the first year of operation includes:

- develop watershed-based wetlands restoration site selection criteria;
- conduct wetlands banking feasibility study;
- inventory current restoration projects;
- refine site selection criteria;
- develop criteria for evaluating restoration success; and
- inventory potential restoration sites.

The Wetlands Restoration and Banking Program will explore links to other federal, state, local or non-profit agency efforts to restore wetlands in Massachusetts and seek to develop a coordinated approach among these groups. Further, this program represents a new component of the Department's implementation of the Massachusetts Clean Water Strategy which seeks to analyze impacts to critical habitats from stormwater and to develop aquatic resource rehabilitation strategies on a watershed basis.

3.6.4 Massachusetts Wetlands Protection Legislation

Due to the loss of thousands of valuable acres of wetlands in Massachusetts over past decades, the need to protect the remaining wetland resource areas in the Commonwealth is paramount. Massachusetts led the nation in wetlands protection by passing the first-ever statute in 1963 for coastal wetlands protection. A statute for inland wetlands protection was passed in 1965. In 1972 the two laws were consolidated to form the State's Wetlands Protection Act. The Act gives initial permit review authority to local conservation commissions, volunteer boards of from 3 to 7 appointed members. All 351 cities and towns in the Commonwealth are required to have a conservation commission. If a conservation commission is not established, then the local Board of Selectmen or the Mayor performs this function. The Wetlands Protection Act requires these commissions to review and regulate activities which propose to remove, fill, dredge, or alter wetlands. Permits may be granted or denied based on impacts to the eight interests for which wetlands are protected: public and private water supply, groundwater supply, prevention of pollution, storm damage prevention, prevention of flooding, protection of fisheries, protection of land containing shellfish, and wildlife habitat. Although wetlands are also considered to have aesthetic and recreational values, the current wetland regulations do not allow these attributes to be considered in the regulating of activities in and around wetlands resource areas.

The Massachusetts regulations are among the most strict wetlands protection laws in the country. With passage of the coastal wetlands regulations, the alteration of valuable saltmarsh areas has been all but eliminated. Since passage of revised inland wetland regulations in 1983, the alteration of vegetated wetlands along inland rivers and streams has been greatly reduced. For almost all projects that come before conservation commissions, these inland wetland regulations prohibit any alteration of wetlands greater than 5000 square feet and require 1:1 replication of any wetland destroyed. For certain classes of projects, however, such as land in agricultural use, forestry, existing roadways, and new public utilities, conservation commissions may allow greater than 5,000 square feet alterations on a case by case basis. Wetland replication may or may not be required for these projects. Additionally, some activities such as bridge repair projects, maintenance of land in agricultural use, mosquito control and maintenance of existing utilities are exempt from the Wetlands Protection Act.

Even with the strict regulations that have been developed over the years, there is a need to do more to protect the Commonwealth's wetlands resources. To meet this challenge, the Department's Division of Wetlands and Waterways has added new technical staff, developed additional wetlands protection policies, and designed an education program to provide technical assistance to conservation commissions

and the general public in the area of wetlands protection. Over the past few years the Department has amended the Wetlands Protection Act Regulations to provide further protection to wetland resource areas.

The Division has proposed to further amend the Wetlands Protection Act to increase protection for wetlands located in inland Areas of Critical Environmental Concern (ACEC's) and for wetlands located in other critical areas such as water supply watersheds. Filling or altering of wetlands in inland ACEC's will be reduced through this increased protection. Cumulative impacts to wetlands in other critical areas would be reduced by requiring an alternatives analysis for limited projects.

In addition, the Division has promulgated new regulations that include five new limited projects: landfill closure, dam safety, groundwater supply, airport tree clearing and 21E assessment of oil and other contaminant releases. These new limited projects will be required to perform an alternative analysis to minimize impacts to wetlands and will increase public health and safety.

For a summary of the Commonwealth's wetland initiatives in 1992 see the Secretary of Executive Office of Environmental Affair's Wetlands Blueprint (Appendix A).

3.6.5 Trends in Wetland Impacts

Since 1978 there have been over 75,000 permit applications (Notices of Intent) submitted to conservation commissions statewide. A total of 40,325 applications to work in or near wetlands resource areas were received by the Department of Environmental Protection (DEP) from 1988 to 1993. While the number of proposals to work in or near wetlands declined from 8,619 in 1988 to 6,262 for 1993, the pressure to develop in wetland areas and buffer zones remains high. During the last four years, almost 43% of the NOI's filed were from Cape Cod and the southeastern part of the State. Projects proposed in the metropolitan Boston and northeast section of Massachusetts accounted for 27% while Central and Western Massachusetts received the final 30% of project applications.

The Division's enforcement efforts declined from over 200 Notices of Noncompliance and Enforcement Orders in 1991 to 122 actions in 1992 and 74 in 1993. Unreported or unpermitted wetland alterations continue to present a problem to the Division. Increased enforcement and compliance efforts, however, are hampered by a continued lack of resources both at the municipal and state levels.

3.6.6 Wetland Protection Program Informational Needs

In order to more accurately determine trends in wetland resources, both in relative health and total acreage by type, monitor enforcement and compliance efforts, and track cumulative wetland loss, the Division must continue to gather up-to-date wetland maps and wetland monitoring data. Federal grants have been obtained to develop wetland assessment procedures and a tracking system for 401 Water Quality Certificates. Additional funds and tools, however, will be required to assess the relative health of wetlands on a priority watershed basis and to finish development of a wetland permit tracking system (WETINFO). Finally, continued state support of the Wetlands Conservancy Program statewide mapping project is essential to the long term effectiveness of Massachusetts' efforts to identify and protect wetland resources.

3.6.7 Coordination with other State Agencies

The Division of Wetlands and Waterways has dedicated considerable effort from 1990 to 1993 in coordinating Division policies and goals with other Divisions within the Department, other Massachusetts agencies, and federal agencies. The Division has provided specific guidance for the following agencies and topics:

Table 3.20 **Notices of Intent submitted to local conservation commissions by region during 1988 to 1993.**

	YEAR					
Region	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
Southeast	3,184	2,987	2,437	2,219	2,979	2,639
Northeast	2,613	1,894	1,475	1,473	1,800	1,692
Central	1,916	1,883	1,182	1,077	1,278	1,396
Western	906	855	739	589	549	535
Totals	**8,619**	**7,619**	**5,833**	**5,358**	**6,606**	**6,262**

- U.S. Army Corps of Engineers
  - 404 Nationwide Permits (and Programmatic General Permits),
  - Wetland Boundary Delineation Review;

- Division of Water Pollution Control (DWPC)
  - Title 5 regulations,
  - Stormwater Guidance,
  - Water Quality Standards (including Antidegradation Policy),
  - 401 Water Quality Certifications,
  - Lake and Pond Management Policy,
  - Nonpoint Source Program;

- Division of Water Supply (DWS)
  - Merrimack River Watershed Project,
  - Wetland impacts from groundwater withdrawals;

- Bureau of Waste Site Cleanup (DWSC)
  - Hazardous Waste Site Cleanup Program (21E) Revision,
  - Natural Resource Damages Committee;

- Department of Food and Agriculture (DFA)
  - Land in Agricultural Use Policy,
  - Farmland Advisory Committee for Wetland Protection regulation changes;

- Department of Fisheries, Wildlife, and Environmental Law Enforcement (DFWELE)
  - FERC review,
  - Lake and Pond Management Policy;

- Department of Environmental Management (DEM)
  - FERC review,
  - new wetlands protection standards for ACECs,
  - Dam Safety Memorandum of Understanding,
  - Lake and Pond Management Policy,
  - Forestry Cutting Practices - GEIR and regulations; and

- Coastal Zone Management (CZM)
  - Storm Policy Implementation,
  - Municipal Harbor Planning,
  - ACEC (coastal) comments,
  - Coastal Bank Policy,
  - Coastal Wetland Regulation Revision - Land Subject to Coastal Storm Flowage Performance Standards,
  - Designated Port Areas, and
  - Barrier Beach Management Planning.

Each of these topics is discussed briefly below.

U.S. Army Corp of Engineers

The Division of Wetlands and Waterways (DWW) worked closely with DWPC, CZM and the ACOE in reviewing the proposed revisions to the 404 Nationwide Permits and setting General or Specific Conditions for all nationwide permit activities. The U. S. Army Corps of Engineers (Corps) has issued a Massachusetts programmatic general permit (PGP) for dredge and fill activities under Section 404 of the Federal Clean Water Act. The Massachusetts PGP has been drafted to provide federal authorization for projects with minimal impacts to wetlands and waterways, using thresholds consistent with the Massachusetts Wetlands Protection Act, the 401 Water Quality Certification Program, and the Massachusetts Environmental Policy Act.

The PGP will replace the Corps' system of nationwide permits and other general permits currently in use. The nationwide permits cover almost 40 different types of activities and resource areas, creating a complex and often confusing system. The federal agencies (the Corps, U.S. Environmental Protection Agency, National Marine Fisheries Service, and U.S. Fish and Wildlife Service), the Department of Environmental Protection (DEP) and the MA Office of Coastal Zone Management have worked together to establish a permit that more efficiently protects wetland resources.

The PGP is based on impacts to wetlands rather than types of activities. Projects altering less than 5,000 square feet (sq. ft.) can proceed without review by federal agencies. Projects affecting between 5,000 sq. ft. and one acre will be screened by the federal agencies. Projects involving the loss of more than one acre must receive an individual permit from the Corps. The PGP will increase wetlands protection because the new 5,000 sq. ft. threshold for screening by federal resource agencies is far lower than the prior thresholds for nationwide permits, allowing these agencies more opportunities to review projects and to identify avoidable wetlands losses. The Department has conditioned the PGP to require compliance with the Wetlands Protection Act, Chapter 91 Waterways licensing, and the 401 Water Quality Certification Program, as applicable.

The PGP was issued in August 1993 for nine months on an interim basis while the Department continues to meet with an advisory committee to draft new 401 regulations. A final PGP will be issued simultaneously with promulgation of the 401 regulations.

Massachusetts wetland regulations use the line where 50% or more of the plant community consists of wetland plant species to define the boundary of bordering vegetated wetlands. Federal delineation methodology uses vegetation, soils and hydrology to determine wetland boundaries. Wetland boundaries determined by these methods can differ depending on site characteristics and other factors. To help minimize differences in federal versus state boundary determinations, DWW worked with governmental and non-governmental agencies to develop new regulations concerning boundary delineations. These draft state regulations, which will allow plants and indicators of wetland hydrology to be used to delineate wetlands, are scheduled for release in Spring 1994.

Division of Water Pollution Control

DWW has worked closely with DWPC in incorporating specific wetland criteria in the Surface Water Quality Standards. Progress to date includes: incorporating wetland areas in the definition of state waters; designating uses for wetlands, adopting aesthetic narrative criteria, adopting very general numeric criteria, and drafting an antidegradation policy. Completing the Antidegradation Policy, developing additional decision criteria for Outstanding Resource Waters, developing a general biological narrative statement, and folding these topics into the 401 Water Quality Certification Program are tasks which need to be addressed.

Most of the six basic requirements for wetland water quality standards recommended by the EPA have been incorporated, in at least a general form, into Massachusetts Surface Water Quality Standards. Specific accomplishments to date include:

- defining wetlands as state waters;
- designating all wetlands as "High Quality Waters", or as "Outstanding Resource Waters" if they are located in critical areas such as water supply watersheds or specific sections of Areas of Critical Environmental Concern. Additionally, certified vernal pools which provide important wildlife habitat are separately identified and designated as Outstanding Resource Waters;
- adopting aesthetic narrative criteria;
- drafting an antidegradation policy which is currently being reviewed.

The Antidegradation Policy protects all wetlands for their existing uses. Wetlands are also protected as significant Resources Waters. This means there can be no lowering of water quality in wetlands without a variance. Critical wetland areas are designated as Outstanding Resource Waters where no degradation is allowed.

Additional work is required to: complete and implement the antidegradation policy; draft narrative biological criteria; develop more specific numeric criteria for appropriate parameters; develop selection criteria for designating wetlands as Outstanding Resource Waters; and incorporate these standards and criteria into the water quality certification process.

DWW is working with DWPC to develop regulations for the 401 Water Quality Certification Program. A Steering Committee and Work Group, composed of Division Directors and DWW-DWPC staff members, respectively, are currently reviewing a draft set of regulations for the 401 Water Quality Certification Program. Public review and comment plus promulgation of these regulations are anticipated during 1994.

For the Nonpoint Source Program, DWW has participated in the Advisory Committee and reviewed project proposals, the Municipal Assistance Manual, and drafts of the Nonpoint Source Management Plan.

DWW has reviewed the proposed Title 5 regulations and has worked with DWPC to establish setback distances for septic tanks from wetlands and other water resources. Title 5 requires a 50 foot setback from wetlands and other water resources for all septic system components.

DWW and DWPC jointly developed Coastal Storm Regulations in the wake of Hurricane Bob and the October Storm. These regulations prohibit the rebuilding of structures that were more than 50% destroyed. Further, tight tanks or mounded septic systems are prohibited for new construction in velocity zones.

DWW has also participated in an EOEA-wide effort to produce a policy concerning lake and pond management in Massachusetts. This policy sets forth a clear set of goals for state agencies, consultants and lake users to follow in protecting and managing lakes and ponds.

Division of Water Supply

DWW's Wetlands Conservancy Program has assisted the Division of Water Supply on a pilot project to protect water supply resources in the Merrimack River watershed. Wetland resources located within watersheds of surface water supplies have been identified using the Conservancy Program's CIR photos. Increased protection of these critical wetlands by implementing zoning changes and other BMP's will be promoted by the outreach component of this project.

New groundwater withdrawal permits issued under the Water Management Act, M.G.L., C.21G, for water withdrawals now require that wetland monitoring data be submitted to the Division of Water Supply as a permit condition when potential impacts on wetlands are a concern. Information on abundance and diversity of vegetation in wetland areas adjacent to water withdrawals will be collected on an annual basis and submitted to DWS for review at the five year review of the permits. This data will be used to determine if specific withdrawals should be limited to protect wetland resources.

Bureau of Waste Site Cleanup (Division of Hazardous Waste)

DWW is playing a major role in the Department's efforts to revise the Hazardous Waste Site Cleanup Program (21E) in order to ensure maximum protection of wetlands. The Bureau of Resource Protection participated in Bureau of Waste Site Cleanup's redesign of its 21E program which will address issues of high priority sites, appropriate clean-up technologies, and clean-up levels. A Bureau of Resource Protection team has been assembled including a representative from

the DWW to look at water resources, including wetlands, in this analysis. Additionally, DWW is participating in the development of an Ecological Risk Assessment Guidance Manual for the 21E Program.

DWW has participated in developing natural resource damages claims for degraded wetland resources on Superfund and 21E sites and is represented on the Technical Advisory Committee for New Bedford Harbor. This Committee advises the federal and state Trustee Council which oversees expenditure of natural resource damages funds on appropriate resource restoration projects for New Bedford Harbor.

Department of Food and Agriculture

DWW has promulgated new wetland regulations which clarify agricultural exemptions. DWW along with the Department of Food and Agriculture (FDA) has established a Farmland Advisory Committee with representatives from the Soil Conservation Service, UMASS Cooperative Extension Service, the Small Farm Institute, and conservation commissions. Based in part on comments from this committee, the Wetlands Protection Regulations as they apply to agricultural activities were revised with provisions to minimize agricultural impacts to wetland resources. A guidance document to assist farmers, conservation commissions, and other interested parties with interpretation of the Wetland Protection Act regulations pertaining to farming activities is currently under development. This guidance will be published in cooperation with the Soil Conservation Service and made available in conjunction with the state training for the Revised Agriculture Regulations to be conducted during 1994.

DWW is an active member of the Vegetation Management Advisory Board which reviews plans submitted to DFA for controlling vegetation on Utility Rights-of-Ways. DWW is working closely with DFA and utility representatives to examine the short term environmental fate of herbicides applied in or near wetlands.

Department of Fisheries, Wildlife, and Environmental Law Enforcement

The Heritage Program has a formal role in the Division's wetland permit process. Vernal pools and rare species habitat are specifically addressed at 310 CMR 10.57 and 10.59 of the Wetlands Protection Regulations. Boundaries for vernal pools and rare species habitat are established by the Division of Fisheries and Wildlife and the Natural Heritage Program, respectively. Projects which are located within identified boundaries for rare species habitat are required to submit their proposal to the Heritage Program for their review and comment. The Wetlands Protection Regulations give the Heritage Program's opinion on potential impacts to rare species a presumption that their opinion is correct. This presumption is rebuttable by the project proponent only if clear evidence to the contrary can be presented. A similar procedure exists to protect wetland interests in vernal pool habitats. DWW has proposed several regulatory revisions to streamline this process.

In 1992 the Heritage Program enacted regulations to protect all rare wildlife and plant species habitat. DWW worked closely with the Heritage Program in the establishment of these regulations to ensure heritage and wetlands protection regulations were compatible.

Department of Environmental Management (DEM)

DWW, in consultation with DEM, has revised the Wetlands Protection regulations pertaining to filling bordering vegetated wetland in Areas of Critical Environmental Concern to increase protection of these important areas. The previous maximum limits of fill that could be placed in wetlands, 5,000 square feet of bordering vegetated wetland and 500 square feet of a finger-like projection from a wetland, are eliminated. Limited projects would be unaffected by this change and therefore some inland wetland areas in ACECs could be filled.

DWW has drafted two Memorandums of Understanding (MOU) with DEM. One MOU focuses on the Forestry Cutting Practices Act, its supporting regulations and the review of forestry cutting plans relative to wetland impacts. It is anticipated that the Forestry Cutting MOU will be enacted in Spring 1994. The other MOU which addresses safe operation and maintenance of dams, the avoidance or minimization of wetland impacts from these activities, and the procedure for notification to local conservation commissions after emergency water withdrawals was enacted in 1993.

DWW has promulgated new wetland regulations with a provision that activities pertaining to dam safety, operation, and maintenance will be considered a limited project.

DWW has maintained on-going communications with the DEM on the Generic Environmental Impact Report (GEIR) on Forestland Management Practices relative to forestland harvesting and wetland impacts. The Division also participated in the Technical Advisory Committee for this GEIR. In conjunction with the development of the GEIR, DWW has also initiated a review of and input to the proposed revisions to the Forestry Cutting Practices Regulations, 304 CMR 11.00.

DWW, collaborating with DEM, DFWELE, and the Energy Facility Siting Council, continues to provide comments for the FERC review of two types of projects: Hydroplant relicensing, and Energy Pipeline projects.

DWW reviews and comments on the suitability of all inland wetland resources proposed for inland ACEC designation.

Coastal Zone Management (CZM)

CZM provided much technical assistance to DWW in the preparation of a Coastal Bank Policy (Wetlands Protection Program Policy 92-1, Definition and Delineation Criteria for Coastal Bank) which sets forth procedures to identify the top of a coastal bank. Total extent of the coastal bank, which provides significant storm damage prevention and flood control functions, can be clearly delineated by using the procedures outlined in this policy which was issued on March 3, 1992.

DWW and CZM are reviewing the Coastal Wetland Protection Regulations and Performance Standards concerning Land Subject to Coastal Storm Flowage for possible revisions. The goal is to reduce storm related environmental impacts from coastal development. CZM and DEM worked with the Division to determine the type of coastal structures, moorings, and emergency plans that would be best suited to avoid damage from severe coastal storms.

Through the Municipal Harbor Planning Process, CZM and DWW reviewed a plan proposed for Boston Harbor. This Plan provides protection for harbor resources by placing limits on building heights and density, number of mooring spaces allowed, setting open space requirements, and recommending pier locations.

DWW has participated in a Barrier Beach Management Task Force with CZM and other agencies to develop a clear set of guidelines and a list of recommended conditions for activities - both construction and recreational - on barrier beaches. Guidelines will be issued by this Task Force in February 1994.

3.6.8 401 Water Quality Certification

As discussed previously, the Division of Wetlands and Waterways has incorporated the 401 Water Quality Certification Process into the Wetlands Protection Program whenever wetlands filling is involved. The 401 Certification program provides additional protection to wetland resources in a number of ways. For instance, no direct discharge of untreated surface water is permitted; all discharges must be pretreated by an appropriate practice such as retention ponds, detention ponds, diffusers, or oil and grease traps. Additional protection of resource areas is also provided by erosion control conditions placed on construction activities.

The Wetlands Protection Act provides for a number of limited projects including roadway crossings of wetlands into areas without another means of access. Replication of filled wetlands is at the discretion of the conservation commission or the Department in such cases and sometimes these crossings are allowed to fill wetland areas without replication being required. The 401 Water Quality Certification process, however, can require wetland replication for these projects. Additional protection of wetland resources can be provided by 401 program when the time limits for project appeals specified in the Wetlands Protection Act expire without an appeal filed by either the conservation commission or the Department. These projects, if they involve significant wetland alterations or further degradation of water quality, can be denied a Water Quality Certificate.

A common problem of both the 401 and Wetlands Protection Program is the failure to check that the project or the mitigation required has been successfully completed according to the specifications provided to the Department or Conservation Commission. More attention and effort must be provided for long term project monitoring, especially wetland replication projects.

3.6.9 Status of FY92 AND FY 93 104(b)(3) Projects

The Division of Wetlands and Waterways has received federal funds through section 104(b)(3) of the Clean Water Act to conduct six projects:

- develop a Two-tier approach to functional assessment of wetlands;
- incorporate the 401 Water Quality Certification Program into the Wetlands Protection Program;
- develop and conduct a Public Education and Training Program;
- develop wetland water quality standards;
- assess levels of compliance with Wetlands Protection Permitting process; and
- develop regulations for the 401 Water Quality Certification Program.

These grants have been awarded to the Division over the past three years and the projects listed above are in various stages of completion. A brief status report for each project is provided below.

Two-tier Assessment
An Interagency Service Agreement was signed with UMASS to conduct the Two-tier assessment. Economic analysis portion of this project is over 75% complete. Outline for functional assessment component is under development at this time.

401 Water Quality Certification Transfer and Regulation Development
The incorporation of the 401 WQC process into the Wetlands Protection Program was completed in October 1992. A final report detailing Department activities in this process was distributed during September 1993. A Permit Tracking Management System which will include the interim 401 Tracking system is under development.

Regulations for the 401 Water Quality Certification process have been drafted and circulated internally and to an advisory committee for review. Training workshops for conservation commissioners are planned for Spring of 1994.

Public Education and Training
Documents completed to date include an informational piece on the Wetlands Conservancy Program, Agriculture regulatory revision training documents, Wetlands Reports, Guide to Divisional Programs, training videos on various aspects of the Wetlands Protection Act (copies to be distributed to all Conservation Commissions at upcoming annual meeting), an updated Enforcement Manual, and a draft general wetlands informational brochure. Other brochures under development include Wetlands Protection Laws, Limited Projects, and Wetlands Public Interests and Functions.

Wetland Water Quality Standards
The Department has focused on the relationship between the 401 regulations and Wetland Water Quality Standards. The draft 401 regulations currently under review are proposed to be used as Wetland Water Quality Standards.

Non-Compliance with Wetland Protection permitting process
This project is approximately 75% complete. Survey of conservation commissions state-wide and permit review in twelve towns are completed and data analyzed. Final report on these phases is being prepared. Aerial Photo analysis approach was drafted (CIRs compared to both earlier CIRs and NWI maps plus orthophoto to orthophoto comparison) with altered wetland sites identified. Field verification of alterations and search of town records for wetlands permits is currently underway.

3.7 Public Health/Aquatic Life Impacts

3.7.1 Fish Tissue Contamination

The Department submits all fish tissue data to the Office of Research and Standards (ORS) and the Department of Public Health for review. U.S. Food and Drug Administration (FDA) "action levels" are available for only eight pesticides, mercury and PCB's. In addition there exists an FDA dioxin advisory criterion for consumption of fish from the Great Lakes. Based on available data, several advisories have been put into effect in Massachusetts. These are presented in Table 3.21.

One new addition since the last reporting period is Sylvan Lake (Cochato River) in the Weymouth River Basin where pesticides and dioxin have been detected.

3.7.2 Fish Kills and Abnormalities

The Massachusetts Division of Fisheries and Wildlife reported 97 fish kills during the period of July 1, 1991 through June 30, 1993. Seventy-eight of these kills occurred in ponds and 19 occurred in streams involving and estimated 220,000 fish. Most fish mortality was due to one major kill (200,000 alewilves) that occurred as the result a single water drawdown. The second largest incident (500 fish) was also due to a drawdown.

Most of the fish kills occur during the warmer months of May through August, usually peaking in May with spawning activity and rapid warming of the water; conditions conducive to increased stress and bacterial infections. Disease continues to be the primary cause of fish kills. Most disease related kills occur in lakes that have been impacted by excess nutrients. Nutrient enrichment may cause a secondary affect of diurnal or seasonally low oxygen levels which induce stress and make fish more suceptible to bacterial infections. Table 3.22 summaries fish kill information for this reporting period.

Fish abnormalities have been recorded at several locations in the state. Fin rot and liver tumors in fish from Boston Harbor are most likely due to the presence of carcinogens. Tumors have been observed on fish from the Sudbury River, Westborough Reservoir, Assabet River Reservoir (A-1 site), Flint Pond in Shrewsbury, Lake Chauncey, Westborough, Fort Meadow Reservoir, Marlborough and Quaboag Pond, East Brookfield. The cause of these abnormalities is unknown. It is speculated that they are genetically induced rather than pollution induced.

3.7.3 Sediment Contamination

There are no numerical sediment criteria in Massachusetts regulations. Therefore, sediments are considered to have elevated levels of contamination when:

1) There is a demonstrated biological impact determined by fish tissue analysis;

TABLE 3.21

MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH
FRESHWATER FISH CONSUMPTION ADVISORY LIST

Waterbody	Advisory Issuance Date	Contaminant(s)	Affected Fish Species	Public Health Advisory Code
Boston Harbor and Quincy Bay	June 1988	Multiple	Lobster Tomalley	P1 and children
Cochato River	September 1992	See Sylvan Lake	Brown Bullhead, Common Carp, American eel	P1,P2,P3
Connecticut River	March 1990	Polychlorinated biphenyls (PCBs)	Channel and White Catfish, American eel & Yellow Perch	P2
Copicut River & Cornell Pond	July 1989	PCBs	American eel	P2
Heard Pond	See Sudbury River	See Sudbury River		
Hocomoco Pond	April 1986 (EPA Issued)	PAHs	All species	P6
Hoosic River	April 1989	PCBs	Brown Trout	P1,P2,P3
Housatonic River	April 1982	PCBs	Fish, Frogs and Turtles	P2
Ice Pond	See Sylvan Lake	See Sylvan Lake	See Sylvan Lake	P1,P2,P3
Lake Winthrop	March 1986	Dioxin	All species	P6
Mill River	May 1992	PCBs	All species	P1,P4
Millers River & tributaries below the confluence with the Otter River	March 1988	PCBs	Brown Trout and American eel	P1,P2,P3
Muddy River	May 1992	PCBs	Brown Bullhead, Common Carp, American eel	P1,P2,P3
New Bedford Harbor	1979	PCBs	*	P6
Otter River within a half mile from the Millers River	March 1990	PCBs	White Sucker & Brown Bullhead	P2

TABLE 3.21 (Continued)

MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH
FRESHWATER FISH CONSUMPTION ADVISORY LIST

Waterbody	Advisory Issuance Date	Contaminant(s)	Affected Fish Species	Public Health Advisory Code
Quabbin and Wachusett Reservoirs	June 1989	Mercury	Large Lake Trout (>24 inches) Small and Largemouth Bass	p1 and children P2,(1)
Sevenmile River	June 1986	Lead	All species of fish	P6
Sudbury River (2)	March 1986	Mercury	All species of fish	P6
Sylvan Lake	September 1992	Pesticides and Dioxin	Brown Bullhead, Common Carp, American eel	P1,P2,P3
Ten Mile River ()	June 1986	Lead	All species of fish	P6
Statewide	September 1988	not specified	Lobster Tomalley	P1

Public Health Advisory Codes:

P1 = Pregnant women and nursing mothers should not eat fish from this waterbody.
P2 = The general public should not consume any affected fish species from this waterbody.
P3 = The general public should limit consumption of all non-affected fish species from from this waterbody to 2 means/month
P4 = The general public should limit consumption of all fish from this waterbody to 2 meals/month.
P5 = The general public should limit consumption of all fish from this waterbody to 1 meal/month.
P6 = The general public should not consume any fish from this waterbody.

Legend:
(1) The general public may eat one (5 oz.) meal/week of other species & unlimited amounts of lake trout (<24 inches) and salmon.
(2) Sudbury River Fish Consumption Advisory pertains to the extent from Ashland to the confluence with Assabet and Concord Rivers and includes the Stern and Brackett Reservoirs in Framingham.

* Area I - All species (including shellfish)
Area II - eel, flounder, scup, tautog (and lobster)
Area III - (lobstering only)

TABLE 3.22

FISH KILL DATA
JULY 1, 1991 - JUNE 30, 1993

Cause	Number of Incidents
Disease	50
Pollution	10
Dissolved Oyxgen	7
Drawdown	6
Aquatic Plants	4
Spawning	4
Unknown	4
Low Water (natural)	3
Angling	3
Stocking	3
Other	2
Injury	1

TABLE 3.23

CONTAMINATED SEDIMENTS

	Waterbody	Cause
1.	Blackstone River	Metals, Priority Organics
2.	Boston Harbor and Quincy Bay	Metals, Priority Organics
3.	Charles River	Metals, Oil and Grease
4.	Connecticut River	Priority Organics (PCB's)
5.	Copicut River and Cornell Pond	Priority Organics (PCB's)
6.	Hocomonco Pond	Priority Organics (PAH's)
7.	Hoosic River	Priority Organics (PCB's)
8.	Housatonic River	Priority Organics (PCB's)
9.	Lake Winthrop	Priority Organics (Dioxin)
10.	Mill River (Blackstone River Basin)	Priority Organics (PCB's)
11.	Millers River	Priority Organics (PCB's)
12.	Muddy River	Priority Organics (PCB's)
13.	Mystic River/Alewife Brook	Metals, Priority Organics (PCB's, PAH's)
14.	New Bedford Harbor	Priority Organics (PCB's)
15.	North Shore	Metals, Priority Organics
16.	Sudbury River	Metals (Mercury)
17.	Ten Mile River	Metals (Lead)
18.	Sylvan Lake Cochato River	Pesticides, Priority Organics (dioxin)

2) toxicity testing of the water column demonstrates toxicity to standard test organisms that is attributable to sediment contamination; or

3) levels of contaminants in the sediments would result in a Category Three classification for dredge and fill material in accordance with the Massachusetts Dredging and Filling Regulations (314 CMR 9.00).

Table 3.23 contains a list of those waterbodies in the state that are considered to have elevated levels of contaminants and the contaminants of concern.

3.7.4 Shellfish Growing Waters

The shellfish growing areas in Massachusetts divide into two distinct zones. The area north of Cape Cod contains most of the large flats and commerical harvesting potential due to ecological and hydrologic reasons. South of Cape Cod the shellfishing industry is of much less natural importance[1].

During the decade from 1970 to 1980 shellfish beds along the shores of major urban areas were closed due to risk of bacterial contamination. The total area of closure was relatively stable. However, during the period of 1980 to 1989 thousands of additional acres have been closed to shellfishing due to bacterial contamination. Furthermore, these areas included many suburban and rural areas along Cape Cod and the South Shore that were previously thought to be pristine.

In contrast, the area north of Cape Cod has not experienced as rapid a rise in the rate of closures but the current conditions contains extensive closures. In this zone there are "Restricted Areas" where specially licensed diggers harvest moderately contaminated (with coliform bacteria) soft-shell clams for purification at the state-operated purification plant in Newburyport. All waters adjacent to Boston, Quincy Hull, Braintree, Weymouth, Hingham and Winthrop are closed or restricted. North of the Boston metropolitan area approximately 36% of the productive flats are open.

Table 3.24 provides a beakdown of the acres of shellfish closures in the State. In addition to 8% of the total acres closed due to bacterial contamination, it is estimated that another 22% of the state's waters are closed due to management closures. Management closures occur in areas that are unsampled due to lack of available resources.

The data on shellfish closures provides valuable information on the areas of marine waters that were not assessed. The indications are that coastal water quality is deteriorating due to nonpoint sources of pollution. This condition is most probably due to rapid development of the coast, particularly in the area of Cape Cod.

3.7.6 Bathing Area Closures

There is no compilation of monitoring data on beach closures on a state-wide basis. Municipal public health offices have authority and there is a lack of uniformity in monitoring practices.

The Department of Public Health's bacteria standard is an instantaneous level of 1000 total coliform/100 ml and biweekly sampling. However some areas may use a level of 200 fecal coliform/100 ml and/or 104 enterococcus/100 ml. Usual monitoring frequencies are biweekly or weekly during the summer months.

The Natural Resources Defense Council (NRDC, July 1993) contacted several shoreline communities in Massachusetts including the MDC, all municipalities from Quincy to Plymouth, Lynn, Swampscott, the Barnstable County municipalities and Crane Beach in Ipswich. Their survey showed 59 closures/advisories in these areas for 1991, and 60 closing for 1992, where the count is compiled of a single

[1] Massachusetts Division of Fisheries and Game, 1930.

TABLE 3.24

ACRES OF SHELLFISH CLOSURES

AREA	TOTAL ACRES	ACRES CLOSED	MANAGEMENT CLOSURES
North Coastal	147,280	54,027	34,307
Boston Harbor	8,333	6,518	73
South Coastal	72,733	2,572	20,742
Buzzards Bay	131,331	12,838	9,366
Mt. Hope Bay	8,055	8,055	-
Cape Cod	448,813	7,928	88,684
Islands	384,083	2,147	108,901
Totals	**1,200,626**	**94,084**	**262,072**
Percent	**100%**	**8%**	**22%**

beach being closed for a single day. There were no extended or permanent closings in Massachusetts.

3.7.6 Incidence of Waterborne Disease

There have been no reported incidences of waterborne disease since 1988.

3.8 Public Water Supplies

3.8.1 Sources of Drinking Water Supplies

Almost 60% of community water supplies (serving 3.9 million people) in Massachusetts are surface water sources. Surface water supplies all major urban areas. The Quabbin and Wachusett reservoirs account for about half of these supplies. Springfield, Worcester, New Bedford, Brockton and Fall River are also major surface water supply systems.

Groundwater provides a source of public drinking water for over 40% of the population (2.5 million people). About 400,000 people have private wells as their source of drinking water. (The Department of Public Health regulates private wells in Massachusetts.) Therefore, a total population of 2.9 million is supplied by groundwater sources.

Although 60% of the population is served by surface water, 70% of the towns in Massachusetts rely solely or partially on groundwater:

Public Water System Information

Number of communities in Massachusetts	351
27% rely on ground & surface water	94
42% rely only on groundwater	146
20% rely only on surface water	72
11% rely only on private wells	39
Number of communities relying solely on MWRA	32
Number of Public Water Systems (PWSs) in MA	1517
34% community (PWSs)	514
47% non-community (PWSs)	720
18% non-transient non-community (PWSs)	270
(13 are not yet classified)	

3.8.2 Water Quality

Phase I of the Safe Drinking Water Act Amendments of 1986 (SDWA) established a nationwide testing program for 59 volatile organic compounds (VOCs) in drinking water supplies. There are 8 regulated VOCs for which Maximum Contaminant Levels (MCLs) went into effect January 1989:

Benzene	1,1,-Dichloroethylene
Carbon Tetrachloride	1,1,1-Trichloroethene
para-Dichlorobenzene	Trichloroethylene (TCE)
1,2-Dichloroethane	Vinyl Chloride

The testing program of the 59 VOCs for all public water suppliers was phased in from 1989 to 1991 based on the size of the system. For the first year of testing, surface water supplies were tested once per quarter and groundwater supplies were tested in the first and third quarters. Subsequent testing has been based on system vulnerability to VOC contamination, as determined by the Department. Analyses were performed at commercial laboratories certified for the analysis of VOCs in drinking water. All testing data is reviewed by the Division of Water Supply (DWS) as well as by public health specialists in the Department

of Environmental Protection Office of Research and Standards (ORS). ORS determines the health effects of any detected compounds and advises DWS on situations where a health risk is present.

Current statistics on the number of sources which have detected VOCs (or other contaminants) below 80% of the MCLs are not presented here because a new water quality tracking system is being developed and the data will not be available until 1993. According to 1990 statistics, 40% of the medium and large system water supply sources tested detected VOCs at low levels, only 11 sources showed VOC concentrations that presented a potential health risk.

Phase II of the Safe Drinking Water Act Amendments went into effect January 1993. It establishes MCL's and a monitoring framework for 17 pesticides (12 new and five revised), eight inorganic contaminants, and PCBs. Community water systems and non-transient non-community systems are required to comply with all aspects of the Phase II Rule. Non-community systems will only be required to monitor for nitrate and nitrite. DWS is currently developing waivers for the testing of certain contaminants where it can be determined these are not a threat to communities in Massachusetts.

As of October 1986, contamination had caused closure of public water supplies in 48 communities, resulting in temporary or permanent loss of 111 public water supply wells or wellfields across the state. By March 1989, 16 new communities experienced a loss of supply and six communities had repeat incidents. Since March 1989, three new towns have lost wells to VOC contamination; three towns which have already experienced contamination of wells, had additional wells closed due to contamination; and one town closed its well because of high nitrate levels. One supply was taken off line because of high radon which occurs naturally.

To summarize the October 1992 contaminated sources list for Massachusetts, 83 sources were contaminated by VOCs, 11 contaminated by inorganic compounds, five contaminated by pesticides, three contaminated by bacteria, 37 contaminated by natural causes, and 25 contaminated by two or more types of contamination.

3.8.3 Groundwater Contamination Prevention Measures

To maintain good water quality and prevent future contamination of sources, the Commonwealth of Massachusetts and local authorities are working to develop local protection measures to effectively manage land uses.

Mapping the area contributing to the source is the first necessary step to protect the water quality of that source. Since 1986, the Division of Water Supply has developed and implemented zone of contribution (Zone II) approval criteria for groundwater sources. As of February 1994, 170 approved Zone IIs have been delineated for 385 wells. Eighty-five of the Zone IIs were delineated for new sources and 85 were delineated for existing sources.

Wellhead protection regulations became effective July 1990, for new sources designed to pump over 100,000 gpd (310 CMR 22.2). These regulations require municipalities to prohibit land uses which are potential sources of contamination within Zone IIs. In addition, DWS provides technical assistance to all communities to help develop necessary land use controls at the local level. Many communities have independently developed Groundwater Protection Districts (170) or Watershed Protection Districts (70) or toxic and hazardous materials regulations (121). Groundwater monitoring plans are also required as an early detection measures for some sources.

The Water Management Act permitting process now requires Zone II delineation and Wellhead Protection Requirements; therefore the Division anticipates the number of approved Zone IIs and Wellhead Protection Zoning and Nonzoning Controls to increase significantly over the next few years.

Other programs in the Division of Water Supply which are focused on contamination prevention are the Underground Injection Control Program which actively inspects facilities that may be a threat to the water quality of a source; and the Nonpoint Source Program which focusses on contamination from stormwater and erosion.

3.8.4 Surface Water Contamination Prevention

Watershed protection measures for surface water features are incorporated in several regulations in the Department such as RCRA and Solid Waste.

Much of the DWS technical assistance outreach concerning land use controls and management described for groundwater applies to protection of surface water sources as well. DWS has also prepared Guidance on the Preparation of a Watershed Protection Plan, February 1990. As mentioned above, 75 communities have Watershed Protection Districts.

The Division of Water Supply has completed a mapping project delineating watersheds for all surface water sources. The Metropolitan District Commission (MDC) has mapped the watersheds for sources under their jurisdiction.

The Massachusetts Watershed Protection Act, the Cohen Bill, took effect August 1992. This act sets forth a comprehensive system of land use regulations to prevent pollution of surface water supply sources of the Metropolitan District Commission. The Department submitted a report to the Legislature May 1993 regarding protection of all water supplies in Massachusetts. Specific policies and regulations recommended by this report are now being pursued.

3.8.5 Surface Water Treatment Rule

The Surface Water Treatment Rule, an amendment to the Safe Drinking Water Act, states that all surface water, and groundwater under the influence of surface water, must filter their water supplies by June 30, 1994. Massachusetts has developed criteria to assist towns in complying with this rule at minimal costs. Two separate projects were developed: Groundwater Under the Influence Exemptions from testing for groundwater sources and Avoidance of Filtration Waivers for surface water sources.

Groundwater Under the Influence Exemptions for microparticulate analysis (MPA) testing are granted for groundwater sources:

> 1) greater than 150 feet from a surface water feature, 2) closer than 150 feet but are in a confined aquifer, have a sanitary seal, and have had no coliform violations, 3) closer than 150 feet but the top of the well screen is deeper than 50 feet, there is a sanitary seal, and the source has not had any coliform violations, and 4) bedrock wells which have a sanitary seal, are deeper than 50 feet, are greater than 200 feet from a surface water feature, and have had no coliform violations.

These are the statistics:

Total # of groundwater sources:	1234	
# of exemptions granted:	829	(67% of the total)
# of applications received:	897	(73% of the total)

(note: 90% of sources that applied for exemptions received them)

There was an even distribution of waivers granted throughout the state. All sources which do not meet the exemption criteria must undertake MPA testing in order to evaluate the need for extensive wellhead protection and watershed control or filtration. Springs must automatically undertake the MPA sampling.

Avoidance of Filtration under the Surface Water Treatment Rule Waivers are granted to surface water sources which have demonstrated that they would not be suseptible to microbiological contaminants such as giardia. Thirteen systems (out of 173) applied for a waiver and all were granted waivers.

Waivers were evaluated for nonpoint source pollution which included erosion, fertilizers and pesticides, road runnoff, animal populations and other land use concerns. All other systems will be required to build treatment plants or upgrade their existing plants to filter for microbiological contaminants such as Giardia lambia, viruses, heterotrophic plate count bacteria, Legionella and turbidity. Filtering is required to begin by June 30, 1994.

The Wachusett Reservoir serves 43 towns either fully or partially, and 31 water districts and water departments are currently using unfiltered water supplies and will be determined to need filtration. Sixteen surface water sources will be removed from service and alternate supplies will be developed to avoid the need and expense of developing a filtration plant. Ninety-two towns have at least one water treatment filtration facility.

4.0 GROUNDWATER ASSESSMENT

4.1 Groundwater Discharge Permit Program

On October 15, 1983, the Department of Environmental Protection promulgated two regulations establishing the Massachusetts Groundwater Discharge Permit Program and the Massachusetts Groundwater Quality Standards. These two regulations, identified as Title 314 of the Code of Massachusetts Regulations, Chapters 5.00 and 6.00 respectively, were designated to protect all groundwater of the Commonwealth. Major features of the regulations include a state-wide groundwater classification program and groundwater discharge permit enforcement authority. Under the former, a mechanism has been created for other classification of the Commonwealth's groundwater with respect to protecting its most sensitive use. The three classes of groundwater are:

Class I: Fresh groundwater found in the saturated zone of unconsolidated deposits or unconsolidated rock and bedrock are designated as a source of potable water supply.

Class II: Saline waters found in the saturated zone of the unconsolidated deposits or consolidated rock and bedrock are designated as source of potable mineral waters, for conversion to fresh potable waters, or as raw material for the manufacture of sodium chloride or its derivatives or similar products.

Class III: Fresh and Saline waters found in the saturated zone of unconsolidated deposits or consolidated rock and bedrock and are designated for uses other than that as a source of potable water supply. At a minimum, the most sensitive use of these waters is as a source of non-potable water which may come in contact with, but is not ingested by humans.

Under 314 CMR 6.00, persons desiring a particular classification for a groundwater were given until January 1, 1985 to submit a petition of request to the Department. The Department is currently reviewing all such requests and will assign classification based on the submittal data. Groundwater for which no specific classification petitions have been received will be designated as Class I, thereby affording protection to the most sensitive use - drinking water supply.

Reclassification may also be initiated by a petition which can be accepted at any time.

All petitions must include certain minimum information including a description of the existing groundwater quality, current and potential uses of the groundwater, identification of potentially affected water supplies, and a statement of needs. Petitioners may also be required to submit a hydrogeologic study, the required detail of which will depend on the complexity of the area's geology, hydrology and the potential environmental impacts.

Standards for granting a Class III designation include the following:

1. The groundwater impacted by the classification is under single ownership by the discharger proposing the classification; or

2. The groundwater affected by the classification is not a present or potential source of drinking water because:

    a) the depth of location of the groundwater makes its use as drinking water economically or technologically infeasible; or

b) the groundwater is sufficiently contaminated to make its recovery for drinking water use economically or technologically infeasible; or

c) the discharge is located over a federally-defined Class III well mining area subject to subsidence or catastrophic collapse; or

3. The groundwater affected is a potential source of drinking water, but an alternate source is available and will be provided by the discharger proposing the classification to all existing and potential users of the aquifer affected by the discharge.

Furthermore, once all the above have been fully satisfied, the state will consider potential adverse effects on hydrologically connected surface and groundwater. The state must take into account future as well as present uses of adjacent water and groundwater.

Currently, the protection of groundwater from point sources of pollution is accomplished through the Department's Groundwater Discharge Permit Program administered by the Division of Water Pollution Control. All dischargers of industrial pollutants and dischargers of over 15,000 gallons per day of sanitary wastewaters into the groundwater require a wastewater discharge permit. This includes, but is not limited to: facilities discharging a liquid effluent below the land surface or into a percolation pit, pond or lagoon; facilities discharging a liquid effluent into leaching pits, galleries, chambers, trenches, fields and pipes; facilities discharging a liquid effluent into an injection well; any facility with an unlined pit, pond, lagoon or surface impoundment in which wastewaters or sludges are collected, stored, treated or disposed of; or conveyances that collect and convey stormwater runoff contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances or contact with a leaching facility. During the last year the Division has made significant progress in processing the back log of groundwater discharge permit applications. This effort is to continue until the back log has been depleted.

Discharges to Class I and Class II groundwater must meet the more stringent of either the technology standards or the national primary and secondary drinking water standards, U.S. EPA and State Health Advisories are used as effluent concentration guidelines. Compounds which are considered toxic and for which there is neither a water quality standard nor a health advisory, are prohibited from discharge.

The discharge of sanitary wastewater in excess of 15,000 gallons-per-day requires a minimum of secondary wastewater treatment or its equivalent. All industrial process wastewater discharges are required to meet technology standards and the proposed treatment system must receive Department approval. These measures serve to ensure that the permitted discharge will be in compliance with Class I or Class II standards.

Discharge to Class III groundwater must also meet the more stringent of technology standards or water quality standards, but water quality standards for Class III groundwater are determined on a case-by-case basis and are generally less stringent than those for Class I or Class II aquifers. Water quality standards for Class III groundwater are determined based upon two most sensitive identifiable water uses. At a minimum, Class III groundwater must meet water quality criteria based upon human exposure limits.

In Massachusetts, each permit must contain monitoring requirements to assure compliance with permit limitations and conditions. The Department determines the number of wells, location, dimensions, method of construction, and frequency of reporting on a case-by-case basis. The State has established guidelines for making these determinations, and the guidelines vary according to the type of facility and the aquifer type under consideration. For Class I and Class II groundwater, most of the monitoring will occur at the point where the effluent emerges from a treatment works, disposal system, outlet or point source prior to

being discharged into the ground. For Class III groundwater, the state will require monitoring between the point source and the compliance boundary.

An integral part of the groundwater discharge permit program is the permit review process which encompasses all the divisions within the Department such as Water Supply, Water Pollution Control, Hazardous Waste, and the Wetlands and Waterways. The review process ensures that the environmental concerns particular to each Division within the Department are considered and addressed.

Implementation of the Department's Administrative Penalty Program began on September 2, 1986. Authority granted under the Administrative Penalty Statute allows the Division to assess civil penalties up to $25,000 per day of violation per violation of permit limitations as well as unpermitted discharges. In excess of $610,000 has been assessed by the groundwater section in a total of 40 cases. This program has proven to be a very effective tool in addressing non-compliance cases as well as providing an extra incentive to permittees to maintain compliance.

The majority of groundwater discharge permits issued to date are for sanitary sewage discharged to the ground by small privately owned sewage treatment facilities. The total discharge flow rate is approximately 15 million gallons per day. The responsibility for industrial discharges has been shifted from the Groundwater Regulation Section to the Bureau of Waste Prevention, Industrial Waste Section.

4.2 Other Groundwater Water Quality Issues

In addition to municipal and privately owned wastewater treatment facilities, over 650,000 individual subsurface sewage disposal systems (septic systems), serving approximately 30 percent of the population, mostly in rural areas operate in the Commonwealth. Title 5 of the State Environmental Code (310 CMR 15.00) sets minimum design and sitting criteria for individual subsurface disposal systems. Under the appropriate environmental conditions, these on-site systems can provide a safe and effective means of sanitary waste disposal, particularly in areas of low density development.

However, water quality impacts to both municipal and private drinking water supplies have been documented in densely populated areas which rely on septic systems. Wastewater treatment, even on the level of the individual home system, must be designed and regulated to protect groundwater resources. Revisions to Title 5 are currently being considered in order to better meet this goal.

Septic systems along with wastewater treatment facilities, industrial facilities, restaurants and commercial facilities produce residual waste. Conventional disposal methods such as incineration and landfilling have proven to be both ineffective and expensive. New technologies and methods, such as composting for beneficial uses, are being developed, evaluated and implemented. This may require both administrative and regulatory changes. In addition, waste constituents, particularly toxics, which make residuals so difficult to treat and dispose of properly must be better managed at the source. The recently enacted Toxics Use Reduction Law and the existing industrial pretreatment program are expected to provide relief over the long term. However, the problem exists now and will only worsen with time. The number of treatment facilities available for residual disposal number 53. The capacity of the 53 POTW's for residuals treatment is less than 110 million gallons per year, approximately one-third of the estimated 300 million gallons per year that should receive treatment. Clearly the lack of capacity poses a threat to groundwater resources. Table 4.1 summarizes the activity level of the Groundwater Section during the reporting period.

TABLE 4.1

DWPC GROUNDWATER REGULATION SECTION

January 1, 1992 to January 1, 1994

Groundwater Discharge Permit Program

Applications received	51
Permits issued	69
WWTF's inspected	98

Enforcement

DWPC Notices of Compliance	20
DWPC Administrative Orders issued	6
DWPC Penalty Assessments issued	3
Cases referred to the Attorney General	1

Title 5

Title 5 systems - plan review	349
Variances processed	1,178

4.3 Timely Action Schedule and Fee Provisions

On November 9, 1990 (revised July 28, 1992) the Department promulgated a set of regulations titled Timely Action Schedule and Fee Provisions, identified as 310 CMR 4.00. The purpose of these regulations are to provide for the orderly and efficient administration of the regulatory programs administered by the Department through the establishment of schedules for timely action on permit applications, plan/report review and approval. As part of 310 CMR 4.00, Section 4.03 allows the Department to assess an Annual Compliance Assurance Fee. Basically this sets up a system by which the Department can track and monitor the compliance of existing water pollution control facilities. This also requires that timely inspections are conducted. Whereas, the Timely Action Schedule sets forth time lines by which the Department must act on different phases of the permitting process.

4.4 Causes and Sources of Pollution

A single comprehensive groundwater monitoring program for Massachusetts does not exist at this time. However, considerable data is collected by the Bureau of Waste Site Clean Up through its Chapter 21E program, the Division of Solid Waste, by cities and towns reporting water quality data of public supplies to the Division of Water Supply and by permittees on regulated discharges.

Table 4.2 summarizes data from the Division of Water Supply concerning contaminated public groundwater supplies. In total 206 sources of supply were reported with contamination in 87 municipalities. The list contains all known contamination, not just contamination occurring during the reporting period. Sixty percent of the reported causes of contamination were due to various organic chemicals. Many of these include TCE contamination. Metals pollution accounted for 18% of the reported causes of contamination. Other causes were distributed through chlorides, pathogens, other inorganics, radiation, nutrients, turbidity, pesticides and organic enrichment.

The sources of contamination are largely reported as unknown (49%). Natural sources account for 16% of the reported cases including metals (iron and manganese) contamination and radiation (radon). No other causes predominated. Reports included spills, waste storage, landfills, storage tank leaks, agriculture, septic tanks, highway runoff, salt storage.

TABLE 4.2

CONTAMINATED GROUND SUPPLIES

CAUSES OF CONTAMINATION

CAUSES	NUMBER REPORTED
Organics	130
Metals	39
Unknown	14
Chlorides	10
Pathogens	9
Inorganics	5
Radiation	4
Nutrients	2
Turbidity	2
Pesticides	2
Organic Enrichment	1

SOURCES OF GROUNDWATER CONTAMINATION

SOURCE	NUMBER REPORTED
Unknown	102
Natural	32
Spills	16
Industrial Waste Storage	14
Landfills	12
Storage Tank Leaks	12
Agriculture	6
Septic Tanks	5
Highway Runoff	3
Salt Storage Sites	3
Land Disposal	2

5.0 WATER POLLUTION CONTROL PROGRAMS

5.1 Background

The Department of Environmental Protection is responsible for administering the State's regulatory programs for the protection of air, water and land resources. The organizational structure of the Department is based on four priority areas: Resource Protection, Waste Prevention, Waste Site Cleanup and Municipal Facilities.

(1) Resource Protection: Oversees and coordinates the Water Pollution Control Program, the Water Supply Program, the Wetland and Waterways Program and other water related special projects. It also administers a program for training and certifying wastewater treatment plant operators.

(2) Waste Prevention: Oversees and coordinates the Hazardous Waste Program, the Solid Waste Management Program, and the Air Quality Control Program.

(3) Waste Site Cleanup: Oversees and coordinates cleanups under State and Federal Laws, and any similar cleanup activities. Regional offices have teams that respond to chemical and hazardous waste spills and accidents.

(4) Municipal Facilities: Oversees the planning, design, construction and financing of municipal wastewater treatment facilities.

5.2 Point Source Programs

The Department's Bureau of Municipal Facilities (prior to July, 1988 it was known as the DWPC Construction Grants Program) has been a principal avenue through which substantial restoration of the Commonwealth's surface waters has been accomplished. Since its inception in 1966 (and its financial strengthening by the Federal Amendments to the Clean Waters Act (CWA) of 1972), the Municipal Facilities Program has provided over $3.5 billion for the construction of new or upgraded wastewater treatment facilities and construction or replacement of sewer system components (pump stations, force main sewers, etc.). Although the financial expenditure has been substantial and has resulted in significant water quality improvements, there remains over $7 billion in unfunded wastewater needs and the ultimate success of the program will require continued expenditure of significant funds over the next decade and beyond.

The Municipal Facilities Program develops an annual priority list for construction projects based on a ranking system which is presented at public hearings. Much of the current funding is being expended on the Boston Harbor, South Essex Sewerage District and New Bedford projects. The demand for funds far outstrips their availability, thus creating a backlog of eligible projects and extending the time for abatement programs to be completed. The source and availability of funding is in a state of flux. The majority of the $3.5 billion in funds expended over the past twenty years were federal EPA and state monies provided in the form of grants. Under the provisions of the 1987 Federal Clean Water Act the Congress voted to replace the Federal/State EPA Construction Grant Program with a new State Revolving Loan Program (SRF). The Act authorized funds to be allocated to states through annual capitalization grants through Federal Fiscal Year 1994. These funds when used with the mandatory 20 percent state match are then made available as 1/2 market rate loans to municipalities to help finance critical water pollution abatement projects. Through FY-94, Federal capitalization grants totalling $375 million dollars will be awarded to the Commonwealth. The FY 1995 Federal budget includes additional monies for the SRF in anticipation of a continuation authorization in the pending re-authorization of the Clean Water Act. With over $7 billion in unfunded wastewater needs identified in Massachusetts, it is essential that the re-authorization of the Clean Water Act continues the SRF program on a long term basis.

Local sources of funding to repay the loans and to finance the non-fundable projects is being increased through higher user fees and other financial arrangements. The shift in funding mechanisms will increase the individual contribution from citizens. The Commonwealth Sewer Rate Relief Fund was established in Section 20 of the outside sections of the FY94 appropriation act (Chapter 110 of the Acts of 1993). The purpose was to mitigate the impact of sewer rate increases due to rising debt service. Section 20 appropriated $30,000,000, for this purpose. An additional $40 million is proposed for FY95. Administration of the program was assigned to the Division of Local Services of the Department of Revenue in consultation with the Department of Environmental Protection through this Bureau. As part of this process, the Bureau reviews all Community requests for relief to determine if the debt service is for an eligible project.

The Department will place great emphasis on replacing and upgrading treatment facilities across the Commonwealth to ensure that the environmental benefits gained over the past two decades are not lost. This attitude will allow for the maintenance of a viable infrastructure for sewer systems and treatment facilities across the state. This approach is directly in line with the Department's strong commitment to the preservation of environmental resources.

The Department issues (jointly with U.S. EPA) surface water discharge permits for all discharges to surface waters within Massachusetts. The permits contain effluent limitations for various parameters necessary to achieve compliance with the water quality standards and water uses of the receiving waters. The permit limits dictate the degree of treatment necessary for a wastewater discharge. In addition, the permit contains monitoring and reporting requirements which allow the state and the U.S. EPA to track performance and compliance.

The Department's Regulatory Program undertakes enforcement actions against violators of the Department's regulations or those in non-compliance with discharge permit requirements. Actions that the Department can initiate include: notices of non-compliance; administrative orders; administrative penalties; show cause hearings; and case referrals to the State's Attorney General's Office for action. These regulatory activities will continue to be a vital component of the Department's programs to ensure proper operation of municipal and industrial treatment facilities.

5.3 Nonpoint Source Program

The Nonpoint Source (NPS) Program was established by Section 319 of the Clean Water Act as amended by Congress in 1987. This section requires each state to develop an Assessment Report and implement a NPS Management Plan. The purpose of the NPS Program is to protect and/or enhance water quality through the prevention, control or abatement of nonpoint source of pollution.

Each year Congress appropriates funds for use by the states to implement their NPS Management Plans. Massachusetts has traditionally used these funds to support a core Nonpoint Source Program and administer competitive implementation projects across the state. To date some 35 projects have been funded in the areas of technical assistance, education, training, technology, transfer and demonstration projects to achieve implementation of best management practices.

5.4 Cost/Benefit Assessment

It is difficult to report on the economic and social costs and benefits of actions necessary to achieve the objective of the Clean Water Act. Until such time as procedures become available it is possible to discuss the capital investments in municipal facilities and provide information on the beneficial outcomes of these actions.

Appendix III of the 1992 report presents a paper by Russell A. Isaac, Assistant Chief Engineer for the Department entitled Water Quality Protection by Municipal Wastewater Treatment Facilities. This paper, first presented in the Journal Water Environmental & Technology in June 1991, reports on the improvements in water quality resulting from the construction/operation of publically owned wastewater treatment facilities.

5.5 Special Concerns and Recommendations

1. Widespread Contamination of Water Supplies

The number of public water supply systems being closed due to contamination is increasing. In order to reverse this trend monitoring is being expanded. An inventory of tributaries to surface water supplies has been completed to be used in new surface and groundwater regulations to provide more protection. Ultimately, there must be better stewardship of land areas surrounding wells, reservoirs and recharge areas.

2. Loss of Wetlands

Valuable wetland areas are decreasing in the state, but there is no systematic means of measuring these losses. Statewide wetlands mapping is being improved to determine the current status of wetlands. Critical wetland resources, such as recharge areas, should be delineated for protection. Improved wetland regulations, with better coordination with the surface water quality standards, are being promulgated. Currently, wetlands are protected under the antidegradation provisions of the surface water quality standards. Additional protection through classification and criteria will be pursued.

3. Coastal Water Quality Degradation

Unlike other waterbody types, marine water quality has noticeably deteriorated on parts of the coast over the last ten years. This is especially true in areas such as Cape Cod where nonpoint source pollution has resulted in a ten-fold increase in shellfish beds closures. This downward trend indicates that more management of development and the abatement of nonpoint sources of pollution will be necessary. Point source abatement measures are well underway. Several municipal wastewater facilities have been upgraded from primary to secondary treatment, and plans for upgrading most of the remaining facilities are completed. Upgrading of Boston's Deer Island facility is underway, and already, improvements to the facility have eliminated the discharge of sludge and reduced the impact of combined sewer discharges in Boston Harbor.

4. Prevention and Control of Nonpoint Sources

Pollution due to point sources is rapidly being reduced in river waters. Point sources to marine waters are currently being addressed, and point sources to lakes are largely prohibited. The control of nonpoint sources of pollution is becoming the most important measure to achieve federal CWA objectives. Stormwater runoff and land disposal need to be examined for best management practices of pollution abatement. New methods of monitoring need to be developed in order to: 1) measure previously unmonitored areas of the state for nonpoint source pollution; and 2) distinguish nonpoint source pollution from point source pollution. Improved monitoring of nonpoint sources, such as wet weather sampling, may result in some waterbodies being reassessed from support to partial and nonsupport of uses. A new emphasis on stormwater permitting will result in greater regulation of this source of pollution.

5. Evaluation of Toxic Pollutants

Toxic pollutants affect many of the state's waterbodies. The exact nature and extent of the problem is not known because the monitoring program has been inconsistent. Parametric coverage has increased over the years and more sophisticated methods of analysis have improved detectability. Statewide toxic monitoring for all waterbody types needs to be implemented in a systematic manner. Chemical by chemical monitoring cannot succeed because of the seemingly limitless number of chemicals to be measured. Therefore a program of biological toxicity testing must be implemented to supplement chemical testing. In order to interpret results of monitoring, additional criteria are needed especially for sediments and fish flesh. The evaluation of toxicity must include three components: 1) human health; 2) aquatic life; and 3) bioaccumulation.

6. Threatened Lakes and Ponds

Most of the lake waters that currently meet water quality standards are perceived to be threatened. The causes are cultural eutrophication and acid precipitation. Cultural eutrophication must be controlled by comprehensive watershed management including public education, nonpoint source control and zoning laws. The only long term solution for acid precipitation is source control; lake liming is only an interim measure. Lakes that are currently polluted will be helped by increased attention to nonpoint source control, but reallocation of funding for the State Clean Lakes Program is also needed. Indications are that the current subsurface disposal regulations are inadequate to protect lakes. Revised regulations and better enforcement of regulations are needed.

7. Treatment Facility Upgrading and O&M

Significant gains in water quality have been made through the construction of wastewater treatment facilities. It is essential that this investment be protected through the proper operation and maintenance of these facilities. Operator education programs and funding for maintenance and upgrading or rebuilding facilities are also needed.

8. Policy for Cleanup of Combined Sewer Overflows

Most of the major urban areas in Massachusetts have combined sewers. The construction of treatment plants for municipal point sources and the advent of best management practices for nonpoint sources leaves these significant sources of pollution unaddressed. The Department has adopted a CSO policy that provides engineering targets for cleanup where sewers remain unseparated. EPA has recently adopted its own CSO policy. The Department's policy must be reconciled with the national policy so that the state can move forward on abatement actions.

9. Contamination of Fish Flesh and Sediments

The historical pollution of certain waters has left a legacy of contaminated sediments/fish flesh. This type of pollution will not be remedied by the conventional means; i.e., the construction or upgrading of wastewater treatment plants. Therefore, further study is needed into the methods of abatement and the means of implementing these measures when the polluter may no longer be present.

10. Biomonitoring

Biomonitoring data has proven invaluable in the river assessment. As monitoring resources decrease, the need for biological monitoring becomes more evident. A minimum program must be maintained for rivers; and programs need to be develop for lakes, wetlands and marine waters. As data are collected regulations can be improved by the development of biological criteria.

11. Monitoring Program

The Department's monitoring resources have been decreasing in recent years and this trend is expected to continue. Better coordination and exchange of information with other agencies is needed. More extensive use of qualitative information must also occur. Improved outreach and citizen's monitoring must also be explored.

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